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By Carole S. Tanner and Ray E. Glass

Prepared under Contract No. NAS2-7369 by
HYDROSPACE-CHALLENGER, INC.
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for

AMES RESEARCH CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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SUMMARY

A series of noise measurements were made during engineering evaluation tests of two-segment approaches in a 727-200 aircraft equipped with acoustically treated nacelles. A two-segment approach having a 6-degree upper glide slope angle intercepting the Instrument Landing System (ILS) 2.9-degree glide slope at an altitude of 690 feet gave a 5-EPNdB decrease in measured noise at distances greater than 3 nautical miles from the runway threshold when compared with a normal ILS approach. Several of the noise measurements were taken under adverse weather conditions which were outside the specified limits of FAR Part 36. This may introduce uncertainties into the data from several approaches.

INTRODUCTION

This report presents the results of acoustic measurements made on a 727-200 aircraft during standard ILS and two-segment approaches. The aircraft was equipped with a special purpose glide slope computer using barometric-corrected pressure altitude and slant range to a DME transmitter co-located with the ILS glide slope transmitter as inputs for upper segment computations, and ILS glide slope deviation for lower segment computations.

Additional measurements were made on 737 revenue aircraft using the Stockton Airport. These results are discussed in Appendix A.

The purpose of the acoustical portion of the test was to measure, evaluate, and identify the noise levels during the various approaches. A total of twelve measurement sites were utilized. Five of these were located on or near the extended runway centerline from 1 to 6 nautical miles from runway threshold. The remaining sites were located at various sideline distances along the length of the test range.

The acoustic test flights were conducted on January 10, 26, 27, 29, and 30, 1973 at Stockton Metropolitan Airport.

DEFINITIONS

AT	Auto Throttle - Pilot does not control aircraft power settings
DME	Distance Measuring Equipment - An aircraft approach aid
EPNdB	Unit of measurement of EPNL used instead of unit dB
EPNL	Effective Perceived Noise Level - The value of PNL adjusted for both the presence of discrete frequencies and the time history
EPR	Engine Pressure Ratio - An indication of engine power setting
FAR 36	Federal Aircraft Regulations, Part 36 - Provides procedure to calculate EPNL
IAS	Indicated Air Speed - Air speed as read in aircraft
MT	Manual Throttle - Pilot controls aircraft power settings
PNL	Perceived Noise Level - The perceived noise level at any instant of time, a psychoacoustic unit
$PNLT_{max}$	Maximum Tone Corrected Perceived Noise Level - The maximum value of PNL plus its corresponding tone correction during an aircraft flyover. A PNL and tone correction are calculated every 0.5 second during an EPNL calculation
SR CPA	Slant Range at Closest Point of Approach - The shortest range to aircraft from a given position to the aircraft during a flyover

APPARATUS AND METHODS

Aircraft and Test Profiles

The aircraft used for the tests was a Boeing 727-200 high gross weight version with three Pratt & Whitney JT8D-15 turbofan engines acoustically treated to meet FAR 36 requirements. The aircraft flew two basic test profiles. The first was a standard ILS approach using conventional avionics. The second type was a two-segment approach using the two-segment glide slope computer avionics. A number of variations of the two-segment approach were flown. Table I contains a list identifying the various profiles. These profiles were flown by both the program test pilot and the airline guest pilots as well. Figure 1 illustrates the ILS and two-segment approach paths in terms of altitude versus distance.

The aircraft was instrumented to record on-board a number of flight parameters. These data were time synchronized to the radar tracking and acoustic data using an IRIG B time code.

Table I. Profile Identification

Profile Name	2.9° G/S Intercept Altitude (ft)	Upper G/S Intercept Altitude (ft)	Upper G/S (deg)	Other
ILS 30° Flaps	1800	NA	NA	NA
ILS 40° Flaps	1800	NA	NA	NA
2 Seg 6°/690 ft MT	690	2870	6	Manual Throttle
2 Seg 6°/690 ft AT	690	2870	6	Auto Throttle
2 Seg 6°/1000 ft MT	1000	2870	6	Manual Throttle
2 Seg 6°/500 ft MT	500	2870	6	Manual Throttle
2 Seg 6°/1000 ft (4000) MT	1000	4000	6	Manual Throttle
2 Seg 6.5°/690 ft MT	690	2870	6.5	Manual Throttle
2 Seg 5.2°/690 ft MT	690	2870	5.2	Manual Throttle
ILS Delayed Flaps, Type 1	1800	NA	NA	NA
ILS Delayed Flaps, Type 2	1800	NA	NA	NA
2 Seg 6.5°/500 ft; 1 Dot High on ILS	500	2870	6.5	Manual Throttle

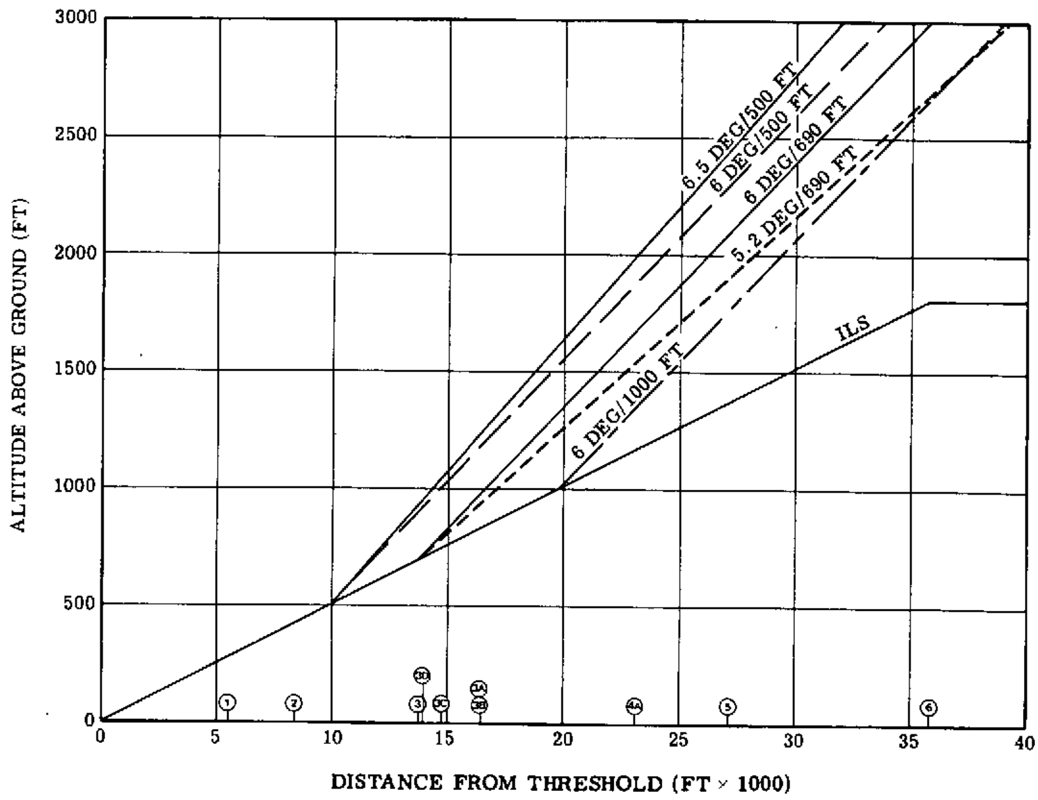


Figure 1. Approach Profiles for 727-200 Tests

Acoustic Measurements

Acoustic data were acquired using battery-operated remote-controlled, portable acquisition systems. Figure 2 presents a block diagram of the systems. The typical system utilizes a two-channel analog tape recorder. One channel records acoustic data and the other channel records an IRIG B time signal. The time is broadcast over a radio link at 162.275 MHz (megahertz). The time is a 1-kHz (kilohertz) amplitude modulated signal. The received time signal serves two functions: 1) it provides a common recorded time base for all systems and 2) the 1-kHz carrier operates a tape motion controller built by Hydrospace-Challenger, Inc. (HCI).

Field technicians checked system operation and tape supply and administered a single-frequency tone calibration at least once an hour.

Each system was calibrated over a frequency range of 50 to 10 000 Hz using an electrical signal. Figure 3 is a typical total system frequency response. The high frequency pre-emphasis is removed during processing but provides a better signal for analog recording since it compensates for high-frequency sound attenuation due to the atmosphere.

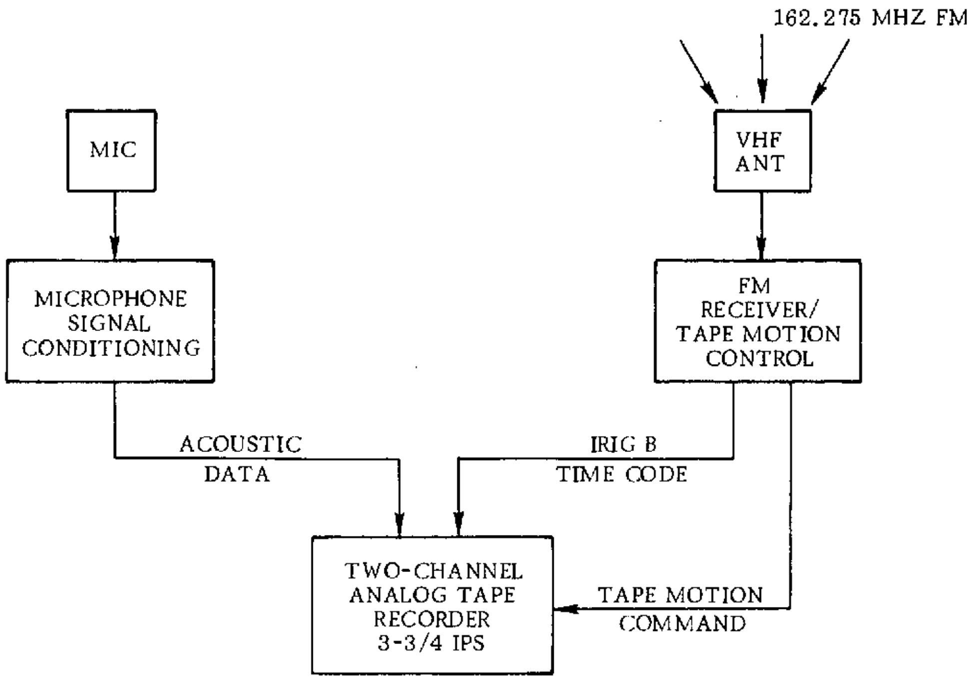


Figure 2. Acoustic Data Acquisition System

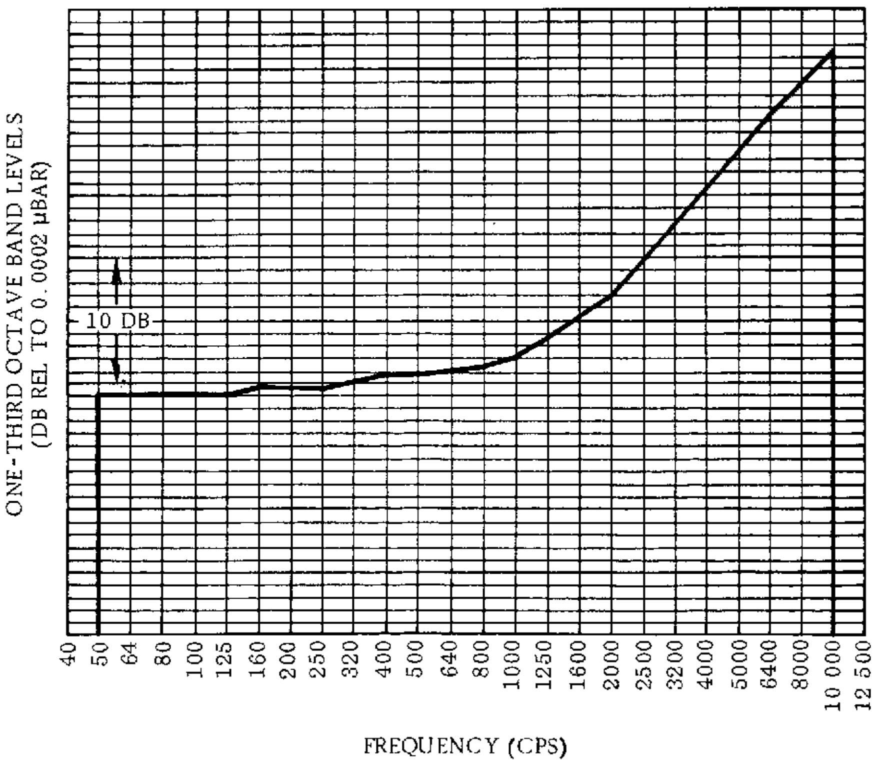


Figure 3. Typical System Response

Acoustical measurements were made at five locations on or near the extended runway centerline and at seven sideline locations. Table II presents the positioning of the sites used during the exercise. All distances along the extended centerline are referenced to the runway threshold.

The sites were located using an orthographic map obtained from the U.S. Geological Survey. Each site was staked and located relative to large features such as trees, roadways, etc. The orthographic photograph was then examined to locate the site. Distances were scaled from this photograph. Figure 4 shows the noise measurement site locations and major topographical features.

It is to be noted that no measurements were made at Site 4. This site was inaccessible due to poor road conditions caused by heavy rains.

Table II. Noise Measurement Site Locations

Site	Distance From Runway Threshold (ft)	Distance Perpendicular to Centerline (ft)
1	5 725	0
2	8 440	70 South
3	13 910	132 North
4	Not Used	Not Used
5	27 430	100 South
6	35 880	90 South
2a	8 550	1505 South
2b	8 455	4212 South
3a	16 410	1400 South
3b	16 400	3490 South
3c	14 750	2540 South
3d	13 927	4595 South
4a	23 087	2917 South

Meteorological Measurements

Meteorological measurements, temperature, relative humidity, and wind speed and direction were made at the van site (Figure 4). In addition, data were obtained from the U.S. Weather Bureau at the Stockton Airport. A comparison of these two sets of data indicated rather large differences in relative humidity. The HCI data were obtained using an Assman psychrometer raised to a height of 20 feet on a pole. During the course of the tests, some difficulty occurred in maintaining an adequate fan speed during aspiration. Therefore, these data are suspect. As a consequence, the data from the Weather Bureau were used to correct data for atmospheric absorption. Table III contains a listing of the appropriate meteorological parameters.

Aircraft Tracking

Radar tracking was provided by a Bell Aerospace radar unit. The radar provided both an on-line two-dimensional plot and analog three-dimensional data. Acoustic data processing was performed using the on-line two-dimensional radar plot. The two dimensions were distance to touchdown and altitude.

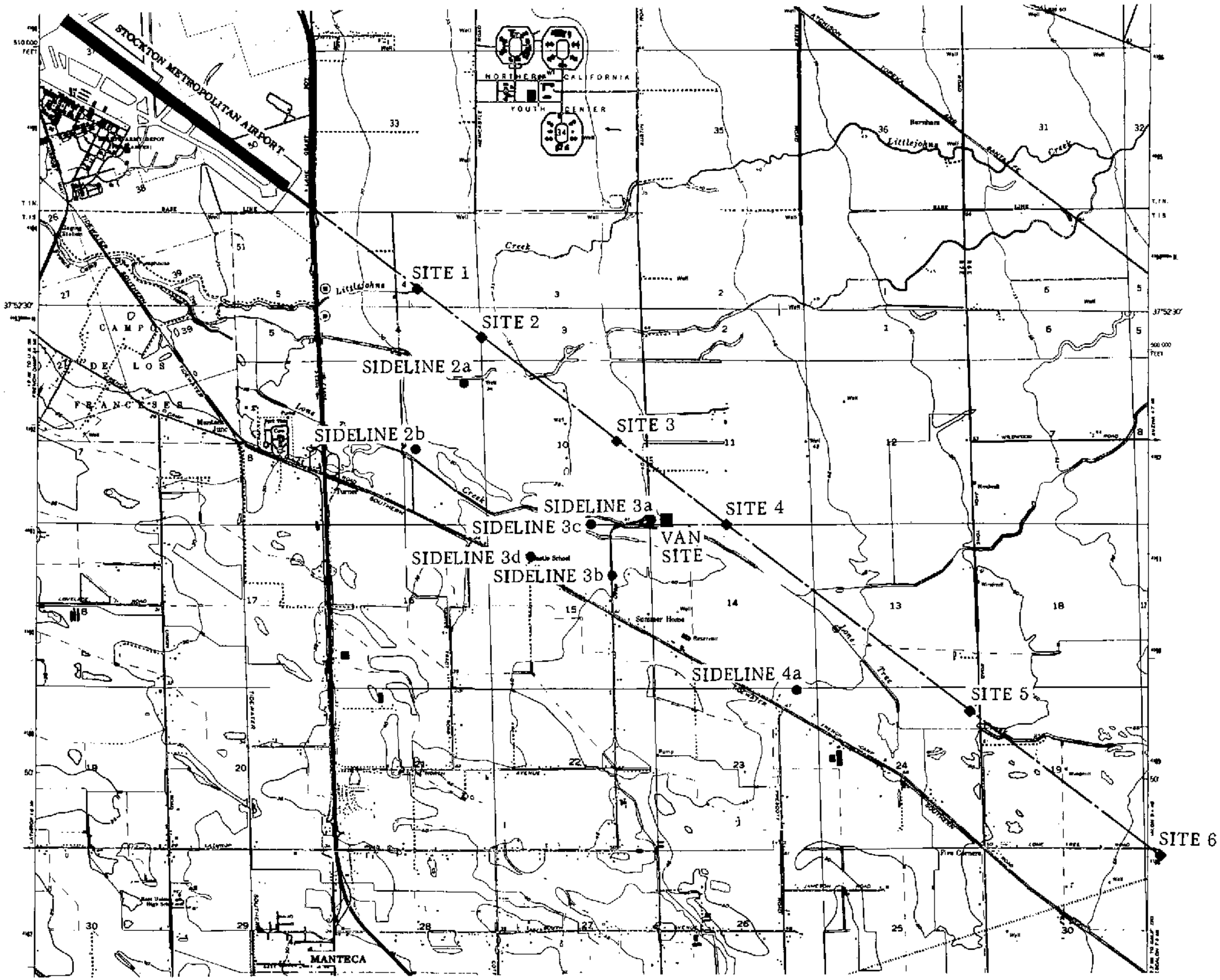


Figure 4. Measurement Site Locations

Table III. Weather Conditions

Date	Time (LST)	Temp (°F)	Relative Humidity (%)	Wind Speed (kt)	Wind Direction (deg)
1-10-73	0900	49	88	6	160
	1000	51	86	8	150
	1100	52	86	6	210
	1200	53	80	Calm	Calm
	1300	55	83	6	110
	1400	55	80	5	090
	1500	55	80	6	120
	1600	56	77	Calm	Calm
	1700	55	80	5	110
1-26-73	1000	41	89	5	360
	1100	43	81	5	290
	1200	44	83	7	360
	1300	44	89	6	020
	1400	46	82	5	040
	1500	48	76	5	050
	1600	48	76	3	140
	1700	47	82	5	080
1-27-73	1000	39	96	4	140
	1100	40	96	4	200
	1200	42	96	5	180
	1300	47	89	3	200
	1400	51	75	4	170
	1500	51	68	6	180
	1600	50	74	5	160
	1700	50	71	5	170
1-29-73	1200	50	77	12	140
	1300	52	81	14	130
	1400	54	82	15	130
1-30-73	1000	48	93	5	220
	1100	47	93	3	240
	1200	49	90	4	240
	1300	51	84	6	290
	1400	53	78	7	300
	1500	53	81	7	270
	1600	53	81	8	300
	1700	53	75	9	340

Although three-dimensional digital tracking data is more accurate, the readily available two-dimensional track will introduce a maximum error in the acoustic results of less than ±0.25 EPNdB for this test. This figure is based on atmospheric absorption differences between the true slant range at the time of maximum tone-corrected perceived noise level ($PNLT_{max}$) and vertical distance at the time of $PNLT_{max}$.

The slant range (SR) at the closest point of approach (CPA) was obtained by scaling the altitude overhead from the radar plots and solving for the altitude height of the triangle knowing the hypotenuse and glide slope.

Acoustic Data Processing

The acoustic data were processed at HCI's San Diego Operations. The processing equipment and the computer program used conform to the requirements of FAR Part 36 (Reference 1). The acoustic data were adjusted for system frequency response, effect of windscreen, grazing incidence, effects of temperature and humidity, and effects of background. Data were not corrected for gross weight differences.

Aircraft Performance Data

Flight, control, and engine parameters were recorded on a digital recording system aboard the aircraft. A flight data entry panel was provided on the flight deck and a time code generator enabled synchronization of the airborne recorder with data recorded at the ground radar and noise data.

During the course of the test, some time synchronization problems between the airborne and ground radar recorder were experienced. For those occurences, performance data relating to a particular flyover were obtained by correlating positional data from the radar and the on-board recordings.

Results and Discussion

The noise measurements for each day of operations were grouped according to the specific flight profile flown. All the data from February 29, 1973 is deleted since there was fog present during these measurements.

Corresponding aircraft performance for each noise data point was obtained from Government-furnished data. The performance values were selected at a time corresponding to the time of maximum tone-corrected perceived noise level.

All airborne data from the January 30, 1973 test had a time synchronization error relative to the radar and noise data. A time correction was computed using two methods. The first method used the noise data and radar analog plots. Previous processing of Site 1 indicated that the time of $PNLT_{max}$ occurs overhead. From this, the aircraft altitude and time overhead are known from scaling the radar analog plots. The time difference between the radar altitude and equal altitude from airborne data represent the time synchronization error.

The second method used was to determine the time difference necessary to equate the radar and DME distances. For this purpose, the following corrections were used:

DME True Distance = DME Measured Distance - 500 feet

Radar True Distance = 1.015 Radar Measured Distance

The time corrections from the two methods were averaged for each run. The average difference between methods was 3 seconds. Performance data obtained using the average correlation are noted on the accompanying tables.

Aircraft gross weight was obtained from cockpit instrumentation. For most tests, a beginning and ending reading was taken. In this instance, a computed gross weight over each microphone site was obtained by assuming that the starting gross weight occurred over Site 6. Then, the time to travel from Site 6 to Site 5 to Site 3, etc, was computed by averaging data for several runs. From this data, it was possible to compute the gross weight change over each site as a percentage of the difference between starting and ending gross weight. For those runs where there was no ending gross weight given, the value used was always the starting gross weight. These are noted in the tables.

The overall gross weight change in any repeat series of flights were examined to determine the maxima, minima, and average values. These overall variations were compared to EPNL gross weight correction data supplied by the aircraft manufacturer and found to lie within the experimental error of that data.

The data are organized in Tables IV through XV for each configuration of interest.

The mean and standard deviation of the noise data given in Table XVI was computed using the following equation.

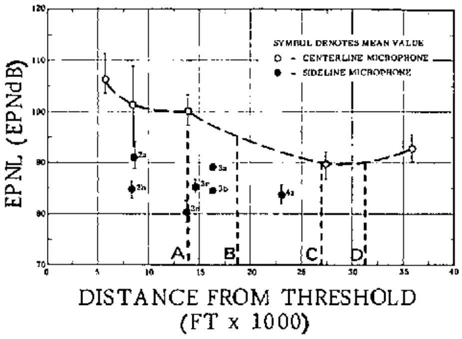
$$\text{Mean} = \sum \frac{S_n}{N}$$

$$\text{Standard Deviation} = \sqrt{\sum \frac{(S_n - \text{Mean})^2}{N - 1}}$$

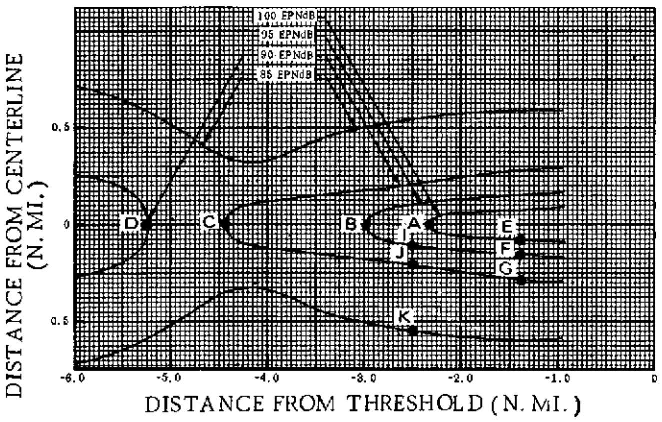
Graphic plots of effective perceived noise level (EPNL) and altitude above ground versus distance from threshold are given in Figures 5 through 23 for each configuration tested. The symbols represent the mean value and the bar through the symbol depicts the range of noise levels at the measurement site. In the absence of a bar, the range of noise levels is contained within the symbol. A computation of noise reduction is made by subtracting the mean EPNL values at each site from the mean EPNL values of the standard ILS 30-degree flap approach. The resulting noise reductions are given in Table XVII.

Noise contours for the standard ILS approach and three types of two-segment approaches are given in Figures 24 through 27. The contours were constructed using plots of mean EPNL versus distance from threshold and EPNL versus distance to the side. The contours are constructed using only measured data and therefore do not extend to the runway threshold.

The contours were constructed using the measured data in Figures 5 to 23 as the basic criteria. The contour mapping consisted of three phases. First, the closure points along the runway centerline were obtained from the appropriate plot of EPNL versus distance from threshold. See Sketch (a) for example. A horizontal line was extended to intersect the smooth curve through the data points. Next, a vertical line was drawn through the point and intersected the distance from threshold. For example, the closure point for 95 EPNdB as obtained from Figure 5 is at a distance of 18 228 feet (3 n.mi.). This closure point is given as Point B on Sketch (b). Other closure points on Sketch (b) labeled A, C, and D were obtained in a similar manner. Note that there are two closure points for 90 EPNdB and that the 85-EPNdB contour does not close for this case.

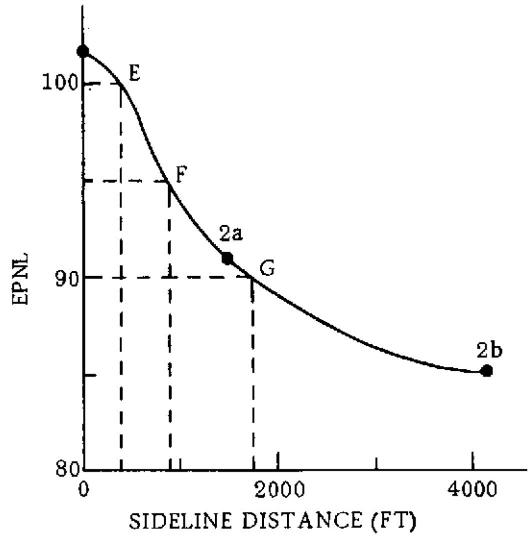


Sketch (a)

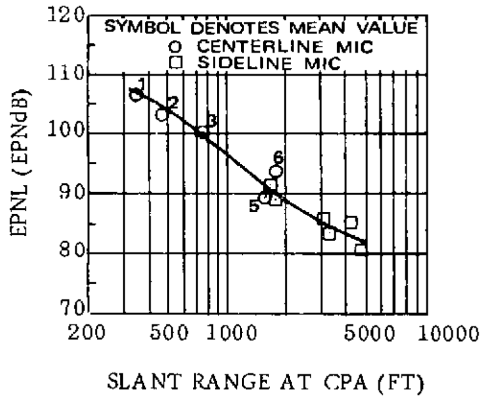


Sketch (b)

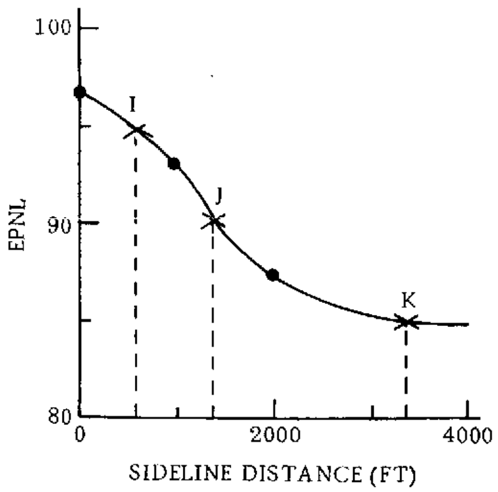
The width of the contour was obtained from the measured sideline noise. Plots of EPNL versus perpendicular distance from centerline were constructed from the measured sideline data. See Sketch (c) for example. Sketch (c) shows the noise data from Sites 2, 2a, and 2b for ILS 30-degree flaps approaches. For a given EPNL value the appropriate sideline distance was obtained from this plot. Points E, F, and G on Sketch (b) were obtained from this sketch. Other points on the contours were obtained in a similar manner from plots of noise data for other sideline locations. In some cases sufficient measured sideline data was not available to construct an appropriate EPNL versus sideline distance plot. In those cases a plot of EPNL versus slant range at CPA (see Sketch (d) for example) was utilized to construct a plot of EPNL versus sideline distance. First, the slant range at CPA was computed for a given altitude and sideline distance and then the EPNL was obtained from Sketch (d) for that slant range. (NOTE: Care must be exercised in constructing the EPNL versus slant range



Sketch (c)



Sketch (d)



Sketch (e)

curve. Greatest accuracy is achieved through the use of a family of parallel curves based on aircraft parameters at the time that an EPNL value was obtained.) Using several EPNL values, the EPNL versus sideline distance plot was constructed. Sketch (e) is an example of a noise versus sideline distance plot obtained in this manner. Sketch (e) is for ILS 30-degree flaps. Contour widths at Points I, J, and K on Sketch (b), which are 2.5 n.mi. from threshold, were obtained from this plot. Similar plots were constructed for other distances from the threshold to obtain the contour widths. Contours are mirror images on either side of centerline.

Note that this latter method (EPNL versus slant range) of constructing a plot of EPNL is subject to greater error because 1) ground attenuation effects are not necessarily included, and 2) noise data may not have been obtained at the proper aircraft power setting.

These contours presented are all hand drawn.

A comparison of the 90-EPNdB contours for the baseline ILS approach and three types of two-segment approaches are given in Figure 28. An estimate of the reduction in area covered by the 90-EPNdB contour was made by integrating the area under the curves between 1.0 and 5.0 nautical miles from threshold. These indicate reductions up to 70 percent in the area included within the 90-EPNdB contour.

CONCLUSIONS

The tests performed at Stockton on the 727-200 with acoustically treated nacelle indicated that two-segment approaches yield significant noise reductions under the flight path as well as to the sides of the flight path. The various two-segment approach configurations flown yield typical noise reductions between 4 EPNdB and 10 EPNdB from 2.5 nautical miles out to 6 nautical miles. The two exceptions occur when only a small number of samples (one or two) were available to calculate the mean value for the configuration at a given measurement site. The delayed flaps provide a measure of noise reduction (5 to 7 EPNdB) in the vicinity of 2.5 nautical miles from threshold, but otherwise tend to show a noise reduction of 1 EPNdB. The best indication of the overall effectiveness of two-segment approaches is the equal noise contour which combines centerline and sideline reductions. A comparison of the 90-EPNdB contour for the ILS 30-degree flaps and two-segment 6-degree/690-foot approaches shows that the most significant noise reduction occurs at a distance greater than 3 nautical miles from threshold. This reduction comes primarily from the increased distance between the source and receiver for the two-segment approach. As the two-segment approach proceeds inbound, the intercept of the ILS occurs at a distance from threshold of approximately 2.3 nautical miles. Thus from this point on, the 90-EPNdB contours are virtually identical except for some differences in engine power settings. The total reduction in area enclosed within the 90-EPNdB contour over a distance of 1 to 5 nautical miles for the two-segment 6-degree/690-foot approach, as compared to the ILS (30-degree flaps) approach, is 0.774 square statute miles. This reduction moves the 90-EPNdB contour closure point approximately 1.5 miles closer to the runway threshold and encloses 56 percent less area.

Hydrospace-Challenger, Inc.,
1360 Rosecrans Street,
San Diego, California, June 29, 1973.

Table IV. Detailed Data Tabulation - Site 1

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1002	106.2	359	1.34	1.30	1.35	133	4.8	29	146 400*	Std ILS 30°
1003	105.1	340	1.33	1.30	1.39	132	3.0	28	145 000*	
2701	104.8	355	-	-	-	-	-	-	152 700	
2707	105.0	345	1.32	1.27	1.32	135	1.5	28	141 800	
2751	103.6	355	1.23	1.23	1.37	142	3.0	29	157 600	
2757	108.3	349	1.33	1.36	1.36	137	3.5	29	146 900	
3001	107.6	340	1.37	1.35	1.39	148	1.1	29	154 000*	
3007	111.1	320	1.44	1.46	1.48	137	3.3	29	138 000*	
3009	108.1	360	1.51	1.48	1.44	146	1.8	28	128 000*	
3016	106.4	340	1.42	1.35	1.32	133	0.3	28	117 000*	
1004	106.1	325	1.35	1.34	1.37	137	2.8	28	143 000*	2 Seg 6°/690 MT
1005	107.1	315	1.37	1.35	1.38	130	3.3	29	141 000*	
1006	103.4	315	1.25	1.24	1.30	133	2.7	29	140 000*	
1007	106.4	315	-	-	-	-	-	-	-	
1008	105.5	313	1.27**	1.22**	1.27**	129**	2.9**	29**	138 000*	
1009	105.4	320	1.37**	1.34**	1.37**	125**	3.7**	29**	134 000*	
2603	107.4	335	1.32	1.24	1.31	143	2.5	29	149 200	
2702	101.1	325	1.10	1.19	1.21	141	2.5	28	150 600	
2703	109.6	360	1.40	1.39	1.42	143	1.9	25	148 100	
2705	104.8	345	1.29	1.24	1.31	138	1.9	29	145 200	
2706	109.9	365	1.44	1.44	1.46	140	2.2	28	143 500	
2708	103.0	350	1.28	1.24	1.26	136	0.8	28	140 500	
2753	108.3	345	1.30	1.37	1.35	145	2.3	29	153 800	
2755	105.2	330	-	-	-	-	-	-	150 200	
2756	107.8	340	-	-	-	-	-	-	148 400	
3002	110.1	350	1.42	1.44	1.45	150	0.7	29	152 000*	
3003	104.5	320	1.28	1.22	1.31	134	2.5	28	147 000*	
3005	105.7	340	1.28	1.25	1.34	142	0.2	29	143 000*	
3006	106.3	340	1.35	1.30	1.38	142	0.6	29	138 600	
3008	108.2	350	1.40	1.35	1.42	141	1.5	28	136 000*	
3010	109.7	320	1.44	1.36	1.34	134	2.4	28	127 000*	
3011	105.4	340	1.38	1.27	1.26	136	1.8	28	125 000*	

* Gross weight at start of run. ** Time correlation correction method used.

Table IV. Detailed Data Tabulation - Site 1, Contd

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
3014	103.5	330	1.33	1.23	1.24	123	3.1	29	118 000*	2 Seg 6°/690 MT
3015	103.7	340	1.37	1.27	1.23	131	0.7	28	118 000*	
3017	103.4	340	1.27	1.15	1.17	119	2.4	29	115 000*	
2604	106.5	345	1.35	1.35	1.37	137	3.0	28	147 500	2 Seg 6°/690 AT
2704	110.6	355	1.42	1.47	1.42	136	2.2	29	146 800	
2754	106.1	360	1.30**	1.42**	1.43**	142**	2.6**	28**	152 200	
3004	106.5	340	1.25	1.19	1.27	145	1.8	28	142 700	
3012	106.0	350	1.32	1.27	1.39	134	1.3	29	123 000*	
3018	104.0	320	1.10	1.12	1.14	120	2.7	29	113 000*	
3019	104.2	360	1.28	1.24	1.37	126	2.3	28	111 000*	
1013	110.1	345	-	-	-	-	-	-	147 000*	2 Seg 6°/1000 MT
1014	107.5	320	1.37	1.34	1.37	131	4.6	28	145 000*	
1015	105.8	350	1.30	1.28	1.30	133	3.2	29	143 000*	
1016	105.8	340	1.35	1.30	1.34	131	3.6	28	140 000*	2 Seg 6°/ 1000 (4000 Start) MT
1020	105.6	400	1.12	1.12	1.12	138	0.1	29	135 000*	2 Seg 6°/500 MT
1021	108.6	375	1.28	1.28	1.30	127	1.9	29	130 000*	
2662	104.1	385	1.36	1.27	1.39	140	0.9	28	129 200	2 Seg 5.2°/ 690 MT
2709	106.8	350	-	-	-	-	-	-	138 500	ILS Delayed Flaps Type 1
2710	102.2	350	1.28**	1.28**	1.37**	138**	1.2**	28**		

Table V. Detailed Data Tabulation - Site 2

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1002	101.7	510	1.27	1.21	1.30	135	3.0	28	146 400*	ILS 30° Flaps
1003	102.6	480	1.28	1.24	1.31	137	3.1	28	145 000*	
2607	102.4	490	-	-	-	-	-	-	139 945	
2651	106.5	530	1.42	1.41	1.47	147	2.9	28	154 263	
2657	108.9	480	1.46	1.45	1.46	135	3.7	28	140 272	
2707	94.0	485	1.31	1.26	1.32	138	2.7	28	141 827	
2757	100.2	500	1.21	1.22	1.34	142	0.5	29	146 945	
3001	100.4	480	1.21	1.17	1.25	152	-0.1	29	154 000*	
3007	92.9	480	1.24	1.19	1.30	141	1.7	29	138 000*	
3009	102.4	500	1.48	1.46	1.42	147	-0.1	28	128 000*	
3016	105.0	480	1.43	1.36	1.34	131	1.8	28	117 000*	
2610	101.6	510	1.51	1.52	1.55	128	2.5	39	133 817	ILS 40° Flaps
1004	99.0	480	1.19	1.17	1.24	137	1.7	28	143 000*	2 Seg 6°/690 MT
1005	100.6	480	1.12	1.14	1.17	132	1.9	29	141 000*	
1006	99.9	480	1.22	1.23	1.25	134	1.1	28	140 000*	
1007	103.4	440	-	-	-	-	-	-	-	
1008	100.5	460	1.34**	1.31**	1.35**	128**	3.1**	28**	138 000*	
1009	99.4	480	1.24**	1.20**	1.24**	127**	3.0**	28**	134 000*	
2608	100.7	500	1.31	1.25	1.28	136	0.6	28	136 954	
2652	108.8	490	1.40	1.28	1.39	149	1.8	29	152 554	
2653	105.9	490	1.40	1.38	1.42	151	1.3	29	150 681	
2655	103.7	505	1.37	1.28	1.33	142	2.4	28	144 272	
2656	106.8	480	-	-	-	-	-	-	142 063	
2658	103.4	495	1.39	1.29	1.36	140	1.6	29	138 645	
2702	92.6	520	1.07	1.12	1.15	142	2.1	29	150 672	
2703	98.4	485	1.33	1.29	1.33	139	2.0	28	148 145	
2705	94.9	505	1.28	1.25	1.24	140	1.2	29	145 236	
2706	97.0	475	1.44	1.42	1.43	135	2.2	28	143 536	
2708	93.0	505	1.17	1.18	1.19	137	0.3	29	140 563	
2753	103.4	480	1.27	1.29	1.34	146	1.2	29	153 854	
2755	102.8	495	-	-	-	-	-	-	150 263	
2756	106.9	480	-	-	-	-	-	-	148 454	

* Gross weight at start of run. ** Time correlation correction method used.

Table V. Detailed Data Tabulation - Site 2, Contd

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2758	105.2	490	-	-	-	-	-	-	143 963	2 Seg 6°/690 MT
3002	102.7	490	1.27	1.21	1.31	151	-0.2	29	152 000*	
3003	104.4	480	1.35	1.27	1.36	136	3.2	29	147 000*	
3005	93.0	500	1.30	1.27	1.37	147	0.6	29	143 000*	
3006	94.6	500	1.31	1.31	1.39	142	0.3	28	140 000*	
3008	92.8	485	1.28	1.26	1.36	141	0.6	28	136 000*	
3010	103.9	480	1.34	1.20	1.21	136	0.4	29	127 000*	
3011	103.6	480	1.37	1.26	1.27	137	1.8	29	125 000*	
3014	104.0	460	1.35	1.29	1.23	120	3.4	28	118 000*	
3015	106.6	480	1.42	1.34	1.30	132	2.2	28	118 000*	
3017	103.1	480	1.31	1.23	1.20	122	2.7	29	117 000*	
2654	103.8	510	1.39	1.44	1.40	137	0.8	29	147 372	2 Seg 6°/690 AT
2704	93.3	515	1.20	1.19	1.22	138	1.8	28	146 836	
2754	103.8	505	1.37**	1.42**	1.47**	142**	2.2**	29**	152 245	
3004	94.0	490	1.33	1.22	1.32	145	1.3	29	142 817	
3012	104.8	480	1.36	1.34	1.40	131	1.4	29	123 000	
3018	100.6	470	1.31	1.24	1.31	121	2.1	29	113 000*	
3019	102.6	490	1.22	1.20	1.23	120	1.7	28	111 000*	
1013	104.7	480	-	-	-	-	-	-	147 000*	2 Seg 6°/1000 MT
1014	100.1	480	1.15	1.15	1.17	132	2.3	29	145 000*	
1015	104.9	480	1.37	1.33	1.37	134	3.6	29	143 000*	
2659	103.8	470	1.32	1.24	1.34	130	3.7	29	136 945	2 Seg 6.5°/ 690 MT
2660	107.2	510	1.42	1.36	1.44	138	2.5	29	134 954	
2661	97.7	505	1.27	1.19	1.27	137	-0.1	28	133 700*	
2662	103.9	520	1.44	1.42	1.49	136	2.4	29	129 281	2 Seg 5.2°/ 690 MT
2663	101.3	480	1.20	1.17	1.22	125	3.5	28	127 900*	
2665	102.1	500	1.22	1.21	1.28	129	2.4	28	126 535	
2709	101.7	485	-	-	-	-	-	-	138 536	ILS Delayed Flaps, Type 1
2759	105.3	490	-	-	-	-	-	-	142 436	ILS Delayed Flaps, Type 2
2760	103.2	500	-	-	-	-	-	-	140 245	
2761	97.4	585	-	-	-	-	-	-	137 954	2 Seg 6.5°/ 500; 1 Dot Hi on ILS
2762	97.5	590	1.05	1.07	1.07	137	-0.2	29	136 500*	

Table VI. Detailed Data Tabulation - Site 3

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1002	100.7	800	1.41	1.34	1.39	133	4.0	29	146 400*	ILS 30° Flaps
1003	99.4	755	1.34	1.31	1.37	135	3.9	28	145 000*	
2607	103.2	720	1.41	1.35	1.43	139	1.9	29	140 030	
2651	102.4	720	1.54	1.54	1.56	142	4.2	28	154 382	
2657	100.5	780	1.37	1.30	1.37	139	1.0	28	140 408	
2701	99.0	760	-	-	-	-	-	-	152 830	
2707	98.1	780	1.31	1.27	1.37	140	1.9	29	141 878	
2751	100.9	780	1.49	1.52	1.54	138	5.0	28	157 756	
2757	98.3	775	1.32	1.34	1.40	143	2.0	29	147 030	
3001	101.1	780	1.50	1.49	1.51	154	1.2	28	154 000*	
3007	101.4	780	1.38	1.35	1.42	142	1.1	29	138 000*	
3009	97.2	740	1.37	1.26	1.20	141	-0.1	28	128 000*	
3016	100.3	780	1.40	1.32	1.29	129	0.6	29	117 000*	
2610	102.3	725	1.40	1.36	1.47	129	-0.5	40	134 038	ILS 40° Flaps
1004	96.0	900	1.29	1.25	1.33	142	-0.6	28	143 000*	2 Seg 6°/690 MT
1005	96.2	880	1.31	1.31	1.37	140	-0.8	29	141 000*	
1006	93.5	880	1.19	1.17	1.20	140	-1.1	28	140 000*	
1007	93.6	860	-	-	-	-	-	-	-	
1008	98.3	900	1.05**	1.07**	1.07**	135**	-0.1**	29**	138 000*	
1009	97.0	930	1.09**	1.09**	1.17**	134**	-0.1**	29**	134 000*	
2603	95.7	770	1.35	1.27	1.34	145	-0.4	28	149 564	
2605	96.4	755	1.24	1.17	1.22	141	-0.1	28	145 856	
2606	97.4	810	1.34	1.22	1.30	149	-0.7	29	143 934	
2608	94.6	750	1.18	1.15	1.19	137	-0.1	28	137 056	
2652	97.2	855	1.15	1.12	1.17	146	-0.1	29	152 656	
2653	96.9	840	1.20	1.16	1.20	155	-1.5	28	150 834	
2655	95.8	880	1.19	1.12	1.19	139	1.6	29	144 408	
2656	97.8	880	-	-	-	-	-	-	142 182	
2658	94.9	870	1.12	1.14	1.17	142	-0.1	28	138 730	
2702	93.5	920	1.07	1.10	1.16	154	-1.9	28	150 808	
2703	92.8	880	1.04	1.06	1.07	147	-1.3	28	148 230	
2705	93.5	920	1.05	1.08	1.13	147	-1.8	28	145 304	
2706	94.3	830	1.05	1.05	1.06	150	-0.6	28	143 604	
2708	96.3	865	1.32	1.31	1.33	138	-0.1	28	140 682	
2753	92.5	855	1.09	1.12	1.20	149	-0.8	29	153 956	
2755	92.2	875	-	-	-	-	-	-	150 382	
2756	93.1	850	-	-	-	-	-	-	148 556	

* Gross weight at start of run. ** Time correlation correction method used.

Table VI. Detailed Data Tabulation, Site 3, Contd

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2758	91.3	890	-	-	-	-	-	-	144 082	2 Seg 6°/690 MT
3002	98.4	860	1.38	1.30	1.38	153	0.3	29	152 000*	
3003	94.8	810	1.51	1.50	1.51	131	-0.1	29	147 000*	
3005	99.3	870	1.35	1.34	1.40	142	0.0	29	143 000*	
3006	96.5	820	1.25	1.22	1.34	144	1.0	29	140 000*	
3008	98.8	840	1.28	1.27	1.37	149	0.0	29	136 000*	
3010	96.2	820	1.30	1.10	1.12	132	-0.1	29	127 000*	
3011	99.2	820	1.37	1.27	1.25	134	-0.5	28	125 000*	
3014	95.8	840	1.07	1.08	1.07	133	0.0	29	118 000*	
3015	98.6	780	1.23	1.19	1.12	129	0.9	29	118 000*	
3017	98.0	860	1.25	1.16	1.11	130	-0.6	29	115 000*	
2604	94.9	850	1.07	1.05	1.05	139	-0.1	29	147 682	2 Seg 6°/690 AT
2654	97.8	880	1.25	1.28	1.28	138	0.7	29	147 508	
2704	94.9	880	1.20	1.29	1.22	137	0.8	29	146 904	
2754	90.8	880	1.09**	1.31**	1.39**	138**	1.9**	29**	152 330	
3004	96.1	870	1.21	1.15	1.24	147	0.0	29	143 038	
3012	97.8	870	1.29	1.25	1.34	133	0.8	29	123 000*	
3018	95.2	850	1.09	1.12	1.13	130	-1.4	29	113 000*	
3019	98.7	900	1.19	1.32	1.42	127	1.0	28	111 000*	
1014	98.8	780	1.27	1.24	1.27	141	1.5	29	145 000*	2 Seg 6°/1000 MT
1016	101.4	710	1.33	1.27	1.32	132	-0.8	29	140 000*	2 Seg 6°/1000 (4000 Start)MT
1020	96.0	940	1.26	1.22	1.27	135	-1.1	28	135 000*	2 Seg 6°/500 MT
1021	93.0	890	1.04	1.06	1.05	138	-2.0	28	130 000*	
2659	94.6	855	1.11	1.10	1.15	139	0.4	28	137 030	2 Seg 6.5°/ 690 MT
2660	97.1	830	1.15	1.16	1.25	131	1.3	29	135 056	
2661	94.6	880	1.07	1.08	1.12	137	-0.4	29	133 700*	
2662	99.1	760	1.23	1.20	1.31	134	1.9	28	129 434	2 Seg 5.2°/ 690 MT
2663	95.3	840	1.20	1.17	1.20	133	-0.1	28	127 900*	
2665	96.0	850	1.19	1.19	1.22	133	-0.1	29	126 790	
2709	94.5	800	-	-	-	-	-	-	138 604	ILS Delayed Flaps, Type 1
2710	95.9	780	1.17**	1.17**	1.25**	149**	-0.4**	23**	137 500*	
2759	92.5	775	-	-	-	-	-	-	142 504	ILS Delayed Flaps, Type 2
2760	94.3	775	-	-	-	-	-	-	140 330	
2761	91.2	1140	-	-	-	-	-	-	138 056	2 Seg 6.5°/ 500; 1 Dot Hi on ILS
2762	89.2	1150	1.05	1.07	1.05	142	-3.2	29	136 500*	

Table VII. Detailed Data Tabulation - Site 5

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1002	87.4	1560	1.07	1.07	1.11	142	0.6	28	146 400*	ILS 30° Flaps
1003	88.4	1440	1.06	1.07	1.07	140	-0.3	28	145 000*	
2607	92.2	1505	1.39	1.29	1.37	137	1.8	28	140 245	
2651	87.5	1615	1.13	1.12	1.15	148	2.5	24	154 683	
2657	88.7	1610	1.11**	1.12**	1.13**	142**	0.5**	28**	140 752	
2701	90.3	1560	-	-	-	-	-	-	153 045	
2707	86.8	1560	1.15	1.17	1.21	147	-0.4	27	142 007	
2751	88.0	1540	1.09	1.10	1.14	151	1.6	24	158 014	
2757	90.2	1530	1.07	1.13	1.17	143	2.4	24	147 245	
3001	91.2	1630	1.36	1.30	1.40	153	0.5	28	154 000*	
3007	92.1	1380	1.28	1.27	1.35	141	0.7	29	138 000*	
3009	92.4	1620	1.53	1.49	1.42	146	-3.2	28	128 000*	
3016	92.3	1460	1.30	1.22	1.21	131	1.3	28	117 000*	
2610	93.8	1620	1.41	1.36	1.48	132	-2.7	39	134 597	ILS 40° Flaps
1004	82.5	2070	1.11	1.11	1.14	147	-2.2	29	143 000*	2 Seg 6°/690 MT
1005	84.2	2070	1.29	1.28	1.32	141	-0.2	29	141 000*	
1006	81.9	2070	1.08	1.13	1.17	139	-1.9	29	140 000*	
1007	83.9	2350	-	-	-	-	-	-	-	
1008	82.9	2360	1.05**	1.07**	1.05**	143**	-2.8**	29**	138 000*	
1009	82.0	2350	1.08**	1.09**	1.12**	136**	-1.1**	28**	134 000*	
2603	85.2	2260	1.09	1.07	1.07	155	-4.1	28	150 166	
2605	84.7	2300	1.20	1.16	1.21	146	-1.5	28	146 114	
2606	85.3	2280	1.12	1.11	1.14	149	-3.3	28	144 321	
2608	87.5	2240	1.05	1.07	1.05	147	-2.2	29	137 314	
2652	84.5	2270	1.14	1.11	1.16	151	-3.5	29	152 914	
2653	85.9	2310	1.17	1.15	1.21	152	-3.3	29	151 221	
2655	83.7	2265	1.09	1.10	1.12	137	-0.1	28	144 752	
2656	86.5	2320	-	-	-	-	-	-	142 483	
2658	85.6	2300	1.11	1.12	1.13	142	-1.4	29	138 945	
2702	85.5	2260	1.31	1.27	1.32	144	-1.1	28	151 152	
2705	83.3	2260	1.22	1.12	1.20	142	-1.2	29	145 476	
2706	85.2	2240	1.21	1.19	1.22	147	-1.3	28	143 776	
2753	86.8	2240	1.05	1.05	1.12	156	-2.2	29	154 214	
2755	85.9	2330	-	-	-	-	-	-	150 683	

* Gross weight at start of run. ** Time correlation correction method used.

Table VII. Detailed Data Tabulation - Site 5, Contd

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2756	85.8	2240	-	-	-	-	-	-	148 814	2 Seg 6°/690 MT
2758	85.0	2280	-	-	-	-	-	-	144 383	
3002	85.4	2290	-	-	-	-	-	-	152 000*	
3003	83.0	2290	1.05	1.07	1.07	145	-2.9	29	147 000*	
3005	84.2	2320	1.16	1.16	1.19	145	-2.2	29	143 000*	
3006	84.1	2280	1.07	1.12	1.15	143	-3.0	29	140 000*	
3010	83.8	2280	1.11	1.07	1.09	138	-4.6	28	127 000*	
3011	82.2	2250	1.14	1.12	1.07	140	-2.5	29	125 000*	
3014	85.3	2380	1.05	1.07	1.09	150	-4.6	28	118 000*	
3015	84.0	2320	1.32	1.25	1.22	142	-3.1	28	118 000*	
2604	85.0	2260	1.17	1.15	1.21	144	-1.3	28	147 983	2 Seg 6°/690 AT
2654	83.9	2270	1.10	1.26	1.21	136	0.7	29	147 852	
2704	87.3	2230	1.15	1.27	1.15	134	-0.1	29	147 076	
3004	82.8	2300	1.25	1.17	1.23	142	-0.3	29	143 597	
3012	84.0	2300	1.05	1.05	1.07	146	-2.4	27	123 000*	
3019	82.1	2350	1.16	1.13	1.21	127	-1.3	28	111 000*	
1013	82.3	2030	1.05	1.07	1.06	149	-2.7	28	147 000*	2 Seg 6°/1000 MT
1014	83.6	2200	1.03	1.05	1.07	146	-1.7	28	145 000*	
1015	84.5	2060	1.07	1.07	1.06	143	-1.8	28	143 000*	
1016	84.9	2000	1.09	1.09	1.11	142	-2.4	28	140 000*	2 Seg 6°/1000 (4000 Start)MT
1020	82.3	2600	1.07	1.07	1.06	138	-1.3	29	135 000*	2 Seg 6°/500 MT
1021	81.6	2600	1.05	1.05	1.05	148	-5.0	28	130 000*	
2659	85.7	2270	1.39	1.30	1.42	140	-0.6	28	137 245	2 Seg 6.5°/ 690 MT
2660	84.7	2440	1.07	1.07	1.09	145	-4.6	28	135 314	
2661	83.4	2360	1.12	1.11	1.15	137	-2.2	28	133 700*	
2662	95.8	1535	1.39	1.38	1.45	136	1.7	28	129 821	2 Seg 5.2°/ 690 MT
2663	81.2	1980	1.11	1.12	1.14	136	-0.3	28	127 900*	
2665	84.9	1960	1.07	1.07	1.07	132	-0.1	28	127 435	
2709	87.7	1500	-	-	-	-	-	-	138 776	ILS Delayed Flaps, Type 1
2710	90.6	1515	1.20**	1.17**	1.21**	158**	3.0**	16**	137 500*	
2759	87.5	1480	-	-	-	-	-	-	142 676	ILS Delayed Flaps, Type 2
2760	91.8	1500	-	-	-	-	-	-	140 545	
2761	83.7	2645	-	-	-	-	-	-	138 314	2 Seg 6.5°/ 500; 1 Dot Hi on ILS
2762	81.9	2640	1.05	1.07	1.06	132	-0.3	28	136 500*	

Table VIII. Detailed Data Tabulation - Site 6

Run	EPNL	SR CPA (ft)	EPR			IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
			#1	#2	#3					
1002	92.1	1680	1.35	1.26	1.36	164	9.1	6	146 400*	ILS 30° Flaps
2607	94.5	1760	1.41	1.35	1.44	143	5.8	24	140 700	
2651	94.2	1780	1.39	1.33	1.43	166	9.1	7	154 900	
2657	92.5	1770	1.35	1.28	1.37	168	8.6	5	141 000	
2701	95.4	1790	-	-	-	-	-	-	153 200	
2707	90.7	1720	1.33	1.31	1.37	167	7.6	12	142 100	
2751	94.4	1725	1.45	1.47	1.50	170	7.6	15	158 200	
2757	90.5	1760	1.22	1.26	1.36	160	6.9	16	147 400*	
3001	95.6	1760	1.37	1.29	1.38	151	7.8	15	154 000*	
3009	92.2	1840	-	-	-	-	-	-	128 000*	
3016	90.0	2045	1.35	1.27	1.29	149	1.8	24	117 000*	
2610	97.3	1800	1.54	1.55	1.57	137	7.1	28	-	ILS 40° Flaps
1004	85.8	2870	1.31	1.22	1.35	165	6.9	14	143 000*	2 Seg 6°/690 MT
1006	84.5	2830	1.24	1.19	1.29	161	6.9	14	140 000*	
1007	85.1	2800	-	-	-	-	-	-	-	
1008	86.1	2880	1.28**	1.23**	1.32**	153**	-0.2**	26**	138 000*	
2603	93.4	2880	1.53	1.52	1.54	161	1.1	28	150 600	
2605	89.9	2965	1.44	1.42	1.44	153	2.5	24	146 300	
2608	91.4	2930	1.52	1.49	1.51	164	1.5	24	137 500	
2652	87.7	2880	1.31	1.20	1.30	167	7.2	11	153 100	
2653	90.0	2840	1.40	1.34	1.42	150	4.1	23	151 500	
2655	84.6	2910	1.21	1.17	1.20	170	6.4	5	145 000	
2656	85.4	2860	-	-	-	-	-	-	142 700	
2702	84.6	2890	1.42	1.39	1.45	168	8.5	6	151 400	
2703	84.8	2950	1.37	1.35	1.46	161	6.9	15	148 600	
2705	85.0	2840	1.33	1.27	1.30	164	6.4	10	145 600	
2706	88.6	2900	1.15	1.14	1.19	164	8.3	7	143 700	
2708	87.8	2825	1.39	1.37	1.44	140	4.7	24	141 200	
2753	84.8	2860	1.19	1.19	1.30	161	4.0	22	154 400	
2755	86.3	2860	-	-	-	-	-	-	150 900	
3002	88.9	2870	-	-	-	-	-	-	152 000*	
3003	85.0	2840	-	-	-	-	-	-	147 000*	

* Gross weight at start of run. ** Time correlation correction method used.

Table VIII. Detailed Data Tabulation - Site 6, Contd

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
3005	91.1	2900	1.55	1.57	1.57	141	4.0	28	143 000*	2 Seg 6°/690 MT
3006	89.7	2850	1.44	1.37	1.47	142	1.1	28	140 000*	
3008	88.9	2830	1.37	1.34	1.43	136	3.2	24	136 000*	
3010	84.7	2840	1.38	1.24	1.35	154	5.5	16	127 000*	
3011	85.4	2940	1.24	1.15	1.15	155	3.8	15	125, 000*	
3014	86.9	2850	1.30	1.25	1.35	167	4.7	5	118, 000*	
3015	88.5	2850	1.44	1.35	1.35	134	2.3	24	118, 000*	
2604	84.9	2965	1.26	1.21	1.30	145	-0.1	28	148, 200	2 Seg 6°/690 AT
2654	85.1	2910	1.13	1.12	1.15	166	6.4	7	148 100	
2704	83.1	2850	1.29	1.29	1.31	163	5.7	15	147 200	
2754	84.6	2860	1.04**	1.05**	1.06**	153**	-0.1**	24**	152 700	
3004	87.5	2830	1.31	1.22	1.33	144	3.1	28	145 000	
3012	86.8	2850	1.37	1.24	1.46	165	5.6	7	123 000*	
3018	87.8	2840	1.32	1.26	1.34	131	1.7	24	113 000*	
3019	86.5	2940	1.54	1.57	1.74	121	1.8	28	111 000*	
1013	85.1	2800	1.39	1.36	1.42	160	6.9	18	147 000*	2 Seg 6°/1000 MT
1014	88.3	2880	1.31	1.22	1.30	162	7.2	15	145 000*	
1015	84.0	2880	1.24	1.18	1.25	156	7.7	10	143 000*	
1016	82.8	3000	1.07	1.09	1.09	141	-2.2	29	140 000*	2 Seg 6°/1000 (4000 Start)MT
1020	86.1	2920	1.35	1.32	1.37	163	7.2	6	135 000*	2 Seg 6°/500 MT
2660	91.9	2920	-	-	-	-	-	-	135 500	2 Seg 6.5°/ 690 MT
2661	90.0	2880	1.42	1.36	1.44	136	6.4	24	133 700*	
2663	84.7	2840	1.14	1.12	1.15	142	0.0	26	130 100*	2 Seg 5.2°/ 690 MT
2665	85.9	2870	1.10	1.12	1.14	134	0.5	28	127 000	
2710	92.4	1760	1.35**	1.31**	1.35**	155**	6.6**	16**	137 500*	ILS Delayed Flaps, Type 1
2759	94.6	1800	-	-	-	-	-	-	142 800	ILS Delayed Flaps, Type 2
2760	90.4	1760	-	-	-	-	-	-	140 700	
2761	86.5	2880	-	-	-	-	-	-	138 500	2 Seg 6.5°/ 500; MT; 1 Dot Hi on ILS
2762	83.9	2920	1.32	1.30	1.34	151	7.6	16	136 500*	

Table IX. Detailed Data Tabulation - Sideline 2a

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
3004	90.0	1679	1.38	1.28	1.39	146	1.0	29	142 817	2 Seg 6°/690 AT
3012	89.0	1676	1.35	1.25	1.40	132	0.6	29	123 000*	
3018	89.3	1667	1.24	1.21	1.25	121	2.3	29	113 000*	
3019	88.0	1686	1.33	1.22	1.40	121	2.6	29	111 000*	
1013	91.8	1670	-	-	-	-	-	-	147 000*	2 Seg 6°/1000 MT
1014	88.6	1670	1.23	1.18	1.25	140	2.4	29	145 000*	
1015	91.1	1670	1.32	1.28	1.32	132	4.1	28	143 000*	
1016	91.0	1670	1.37	1.32	1.36	131	3.8	29	-	2 Seg 6°/1000 (4000 Start)MT
1020	88.1	1724	1.17	1.15	1.17	141	-1.6	29	-	2 Seg 6°/500 MT
1021	86.7	1695	1.12	1.12	1.19	130	1.1	29	-	
1004	88.5	1670	1.19	1.17	1.24	137	1.7	28	143 000*	2 Seg 6°/690 MT
1005	88.6	1670	1.25	1.26	1.29	131	1.8	29	141 000*	
1006	87.1	1670	1.16	1.14	1.17	136	0.0	28	140 000*	
1007	90.6	1630	1.36	1.34	1.37	130	2.7	28	-	
1008	88.3	1665	1.35	1.31	1.34	129	3.9	29	138 000*	
1009	88.0	1670	1.23	1.21	1.23	128	2.2	29	134 000*	
3002	91.4	1655	1.28	1.22	1.31	149	0.7	29	152 000*	
3003	90.3	1667	1.31	1.24	1.32	137	2.9	29	147 000*	
3005	89.0	1676	1.33	1.27	1.35	146	0.6	29	143 000*	
3006	90.4	1676	1.34	1.32	1.39	142	0.8	29	140 000*	
3008	90.0	1676	1.29	1.26	1.35	139	0.2	29	136 000*	
3010	91.3	1675	1.34	1.20	1.21	136	0.4	29	127 000*	
3011	92.0	1676	1.39	1.26	1.27	138	2.0	29	125 000*	
3014	91.4	1664	1.38	1.32	1.30	120	3.3	29	118 000*	
3015	93.3	1676	1.40	1.35	1.32	132	2.5	28	118 000*	
1002	90.0	1680	1.37	1.27	1.36	136	3.3	29	146 400*	ILS 30° Flaps
1003	90.8	1670	1.38	1.32	1.41	135	3.3	29	145 000*	
3001	89.6	1651	1.27	1.22	1.32	154	1.0	29	154 000*	
3007	88.9	1676	1.25	1.19	1.31	143	1.0	29	138 000	
3009	94.0	1676	1.48	1.46	1.36	147	0.2	29	128 000*	
3016	92.7	1676	1.42	1.34	1.35	130	1.8	29	117 000*	

* Gross weight at start of run.

Table X. Detailed Data Tabulation - Sideline 2b

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
3003	81.2	4242	1.37	1.25	1.36	137	3.3	29	147 000*	2 Seg 6°/690 MT
3005	80.8	4249	1.27	1.27	1.35	142	1.5	29	143 000*	
3006	83.4	4249	1.32	1.31	1.39	142	1.2	29	140 000*	
3010	86.2	4246	1.43	1.35	1.34	131	1.8	29	127 000*	
3011	84.0	4246	1.37	1.26	1.26	137	1.8	29	125 000*	
3014	83.8	4246	1.33	1.23	1.24	123	3.1	29	118 000*	
3015	84.8	4247	1.35	1.29	1.23	131	-0.1	28	118 000*	
3017	87.1	4247	1.25	1.17	1.19	124	2.5	28	117 000*	
3007	83.2	4247	1.45	1.46	1.49	140	3.4	29	138 000*	ILS 30° Flaps
3009	86.3	4249	1.51	1.48	1.44	146	0.2	29	128 000*	
3016	85.3	4247	1.38	1.25	1.25	134	1.8	29	117 000*	
3004	81.5	4249	1.25	1.19	1.27	145	1.8	28	142 817	2 Seg 6°/690 AT
3012	81.9	4248	1.34	1.25	1.39	133	2.0	29	123 000*	
3018	82.0	4246	1.21	1.18	1.24	122	3.1	29	113 000*	
3019	80.6	4248	1.31	1.22	1.35	125	2.0	28	111 000*	

Table XI. Detailed Data Tabulation - Sideline 3a

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1016	87.4	1780	1.35	1.30	1.35	134	3.4	29	-	2 Seg 6°/100 (4000 Start)MT
1020	86.1	2060	1.27	1.26	1.31	135	-0.1	29	-	2 Seg 6°/500 MT
1021	84.2	2050	1.04	1.05	1.05	140	-2.1	28	-	
1002	88.4	1786	1.36	1.32	1.38	132	3.8	28	146 400*	ILS 30° Flaps
1003	90.0	1783	1.39	1.36	1.41	136	3.5	29	145 000*	
1004	84.4	1915	1.25	1.27	1.30	140	-0.9	29	143 000*	2 Seg 6°/690 MT
1005	85.1	1905	1.07	1.08	1.11	141	-1.3	29	141 000*	
1006	84.2	1955*	1.20	1.17	1.20	142	-0.9	29	140 000*	
1007	82.9	1900*	1.05	1.08	1.09	137	-1.6	29	-	
1009	84.7	1930	1.09	1.11	1.15	137	-1.8	29	134 000*	
1014	87.0	1775	1.31	1.30	1.32	141	1.4	29	145 000*	2 Seg 6°/1000 MT
1015	86.0	1795	1.20	1.17	1.20	136	1.7	28	-	

* Gross weight at start of run.

Table XII. Detailed Data Tabulation - Sideline 3b

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
1002	84.5	3810	1.37	1.30	1.37	133	4.0	29	146 400*	ILS 30° Flaps
1003	84.8	3805	1.30	1.24	1.34	135	3.1	29	145 000*	
1004	84.5	3860	1.10	1.12	1.20	139	-0.7	29	143 000*	2 Seg 6°/690 MT
1006	85.5		1.19	1.15	1.19	141	0.0	28	140 000*	

Table XIII. Detailed Data Tabulation - Sideline 3c

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2702	83.1	3099	1.07	1.10	1.16	154	-1.9	28	150 808	2 Seg 6°/1000 MT
2703	84.2	3088	1.05	1.05	1.07	150	-0.4	29	148 230	
2705	80.5	3099	1.07	1.07	1.14	151	-2.1	28	145 304	
2706	81.7	3074	1.05	1.06	1.07	151	-1.0	29	143 604	
2708	83.1	3083	1.32	1.27	1.34	137	-0.1	28	140 682	
2753	82.8	3081	1.08	1.12	1.20	151	-0.9	29	153 956	
2755	83.0	3086	-	-	-	-	-	-	150 382	
2758	81.1	3090	-	-	-	-	-	-	144 082	
2761	83.3	3172	-	-	-	-	-	-	138 056	2 Seg 6.5°/500; 1 Dot Hi on ILS
2762	81.3	3175	1.05	1.05	1.05	141	-2.3	29	136 500*	
2701	86.7	3056	-	-	-	-	-	-	152 830	ILS 30° Flaps
2707	84.2	3061	1.29	1.27	1.36	140	1.6	29	141 878	
2751	86.8	3061	1.50	1.52	1.54	140	5.3	28	157 756	
2757	84.9	3059	1.26	1.28	1.37	142	2.6	29	147 030	
2704	85.7	3088	1.27	1.22	1.28	138	0.5	28	146 904	2 Seg 6°/690 AT
2754	81.4	3088	1.05	1.05	1.05	140	-0.1	29	152 330	
2709	82.4	3066	-	-	-	-	-	-	138 604	ILS Delayed Flaps, Type 1
2710	81.8	3062	1.17	1.17	1.26	156	2.4	15	137 500	
2759	82.9	3059	-	-	-	-	-	-	142 504	ILS Delayed Flaps, Type 2
2760	84.0	3059	-	-	-	-	-	-	140 330	

* Gross weight at start of run.

Table XIV. Detailed Data Tabulation - Sideline 3d

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2702	77.1	4840	1.07	1.10	1.15	152	0.9	29	150 808	2 Seg 6°/1000 MT
2705	76.1	4835	1.14	1.11	1.17	149	-1.2	29	145 304	
2706	80.2	4830	1.44	1.42	1.44	136	3.1	28	143 604	
2708	75.2	4835	1.29	1.23	1.28	139	1.1	28	140 682	
2753	78.3	4850	1.27	1.29	1.34	147	0.4	28	153 956	
2756	79.2	4820	-	-	-	-	-	-	148 556	
2758	78.0	4828	-	-	-	-	-	-	144 082	
2701	80.6	4815	-	-	-	-	-	-	152 830	ILS 30° Flaps
2707	78.1	4810	1.31	1.25	1.33	141	1.3	29	141 878	
2751	82.8	4820	1.49	1.54	1.54	141	4.2	29	157 756	
2757	80.0	4802	1.26	1.28	1.37	142	2.5	28	147 030	
2704	76.2	4840	1.20	1.19	1.22	138	2.8	29	146 904	2 Seg 6°/690 AT
2709	74.9	4815	-	-	-	-	-	-	138 604	ILS Delayed Flaps, Type 1
2710	77.3	4820	1.17	1.17	1.27	157	3.5	16	137 500*	
2759	80.2	4808	-	-	-	-	-	-	142 504	ILS Delayed Flaps, Type 2
2760	80.4	4807	-	-	-	-	-	-	140 330	
2761	81.0	4805	-	-	-	-	-	-	138 056	2 Seg 6.5°/500 1 Dot Hi on ILS
2762	78.7	4907	1.05	1.07	1.05	142	-3.2	29	136 500*	

Table XV. Detailed Data Tabulation - Sideline 4a

Run	EPNL	SR CPA (ft)	EPR #1	EPR #2	EPR #3	IAS (knot)	Pitch Attitude (deg)	Flaps (deg)	Gross Weight (lb)	Configuration
2659	78.9	3380	1.12	1.11	1.16	138	-1.6	28	137 000	2 Seg 6.5°/ 690 MT
2660	78.9	3390	1.06	1.05	1.05	143	-3.0	28	135 014	
2661	76.6	3385	1.05	1.05	1.07	140	-2.6	28	133 400*	
2662	83.6	3275	1.27	1.22	1.36	140	0.4	28	129 521	2 Seg 5.2°/ 690 MT
2663	81.5	3355	1.25	1.22	1.27	135	0.4	28	127 600*	
2665	84.5	3355	1.26	1.22	1.29	132	0.0	28	127 135	
2651	82.0	3305	1.33	1.27	1.35	146	1.8	28	154 383	ILS 30° Flaps
2657	85.7	3265	1.52	1.51	1.50	135	3.7	28	140 452	
2610	87.6	3240	1.40	1.43	1.49	123	2.3	40	-	ILS 40° Flaps
2652	79.3	3365	1.32	1.24	1.32	151	-0.4	29	152 614	2 Seg 6°/690 MT
2653	81.0	3380	1.10	1.12	1.16	158	-3.6	29	150 921	
2656	82.7	3375	-	-	-	-	-	-	142 183	
2654	80.1	3395	1.12	1.17	1.15	137	-0.1	29	147 552	2 Seg 6°/690 AT

* Gross weight at start of run.

Table XVI. Mean and Standard Deviation of Noise

Type of Approach		Centerline Sites					Sideline Sites						
		1	2	3	5	6	2a	2b	3a	3b	3c	3d	4a
ILS 30° Flaps	Mean Values	106.6	103.2	100.2	89.8	92.9	91.0	84.9	89.2	84.6	85.4	80.4	83.8
	Std Deviation	±2.2	±4.8	±1.7	±2.1	±2.0	±2.0	±1.6	±1.1	±0.2	±1.7	±1.9	±2.6
	No. Samples	10	11	13	13	11	6	3	2	2	4	4	2
ILS 40° Flaps	Mean Values		101.6	102.3	93.8	97.3							87.6
	Std Deviation		-	-	-	-							-
	No. Samples		1	1	1	1							1
2 Seg 6°/690 ft MT	Mean Values	106.1	101.1	95.7	84.5	87.2	90.0	83.9	84.3	85.0			82.0
	Std Deviation	±2.4	±4.7	±2.2	±1.4	±2.5	±1.7	±2.2	±0.8	±0.7			±3.3
	No. Samples	25	31	34	30	27	15	8	5	2			3
2 Seg 6°/690 ft AT	Mean Values	106.3	101.9	95.8	84.2	85.8	89.1	81.5			83.5	76.2	80.1
	Std Deviation	±2.2	±4.0	±2.5	±1.8	±1.6	±0.8	±0.6			±3.0	-	-
	No. Samples	7	7	8	6	8	4	4			2	1	1
2 Seg 6°/1000 ft MT	Mean Values	107.8	103.2	98.8	83.5	85.8	90.5		86.5		82.4	77.7	
	Std Deviation	±2.2	±2.7	-	±1.1	±2.2	±1.7		±0.7		±1.2	±1.7	
	No. Samples	3	3	1	3	3	3		2		8	7	
2 Seg 6°/500 ft MT	Mean Values	107.1		94.5	81.9	86.1	87.4		85.1				
	Std Deviation	±2.1		±2.1	±0.5	-	±0.9		±1.3				
	No. Samples	2		2	2	1	2		2				
2 Seg 6°/1000 ft (4000) MT	Mean Values	105.8		101.4	84.9	82.8	91.0		87.4				
	Std Deviation	-		-	-	-	-		-				
	No. Samples	1		1	1	1	1		1				
2 Seg 6.5°/690 ft MT	Mean Values		102.9	95.4	84.6	90.9							78.1
	Std Deviation		±4.8	±1.4	±1.1	±1.3							±1.3
	No. Samples		3	3	3	2							3
2 Seg 5.2°/690 ft MT	Mean Values	104.1	102.4	96.8	87.3	85.3							83.2
	Std Deviation	-	±1.3	±2.0	±7.6	±0.8							±1.5
	No. Samples	1	3	3	3	2							3
ILS Delayed Flap, Type 1	Mean Values	104.5	101.7	95.2	89.1	92.4					82.1	76.1	
	Std Deviation	±3.2	-	±1.0	±2.0	-					±0.4	±1.7	
	No. Samples	2	1	2	2	1					2	2	
ILS Delayed Flap, Type 2	Mean Values		104.2	93.4	89.6	92.5					83.4	80.3	
	Std Deviation		±1.5	±1.3	±3.0	±3.0					±0.7	±0.1	
	No. Samples		2	2	2	2					2	2	
2 Seg 6.5°/500 ft 1 Dot High	Mean Values		97.4	90.2	82.9	85.2					82.3	79.8	
	Std Deviation		±0.1	±1.4	±1.4	±1.8					±1.4	±1.6	
	No. Samples		2	2	2	2					2	2	

Table XVII. Noise Reductions

Configuration	EPNL (ILS 30° Flaps) - EPNL											
	Centerline Sites					Sideline Sites						
	1	2	3	5	6	2a	2b	3a	3b	3c	3d	4a
ILS 40° Flaps		1.6	-2.1	-4.0	-4.4							-3.8
2 Seg 6°/690 ft MT	0.5	2.1	4.5	5.3	5.7	1.0	1.0	4.9	-0.4			1.8
2 Seg 6°/690 ft AT	0.3	1.4	4.6	5.6	7.1	1.9	3.4			1.9	4.3	3.7
2 Seg 6°/1000 ft MT	-1.2	0	1.4	6.3	7.1	0.5		2.7		3.0	2.8	
2 Seg 6°/500 ft MT	-0.5		5.7	7.9	6.5	3.6		4.1				
2 Seg 6°/1000 ft(3000) MT	0.8		-1.2	4.9	10.1	0		1.8				
2 Seg 6.5°/690 ft MT		0.3	4.8	5.2	2.0							5.7
2 Seg 5.2°/690 ft AT	2.5	0.8	3.4		7.6							0.6
ILS Delayed Flaps, Type 1	2.1	1.5	5.0	0.7	0.5					3.3	4.4	
ILS Delayed Flaps, Type 2		-1.0	6.8	0.2	0.4					2.0	0.2	
2 Seg 6.5°/500 ft, 1 Dot High		5.8	10.0	6.9	7.7					3.1	0.7	

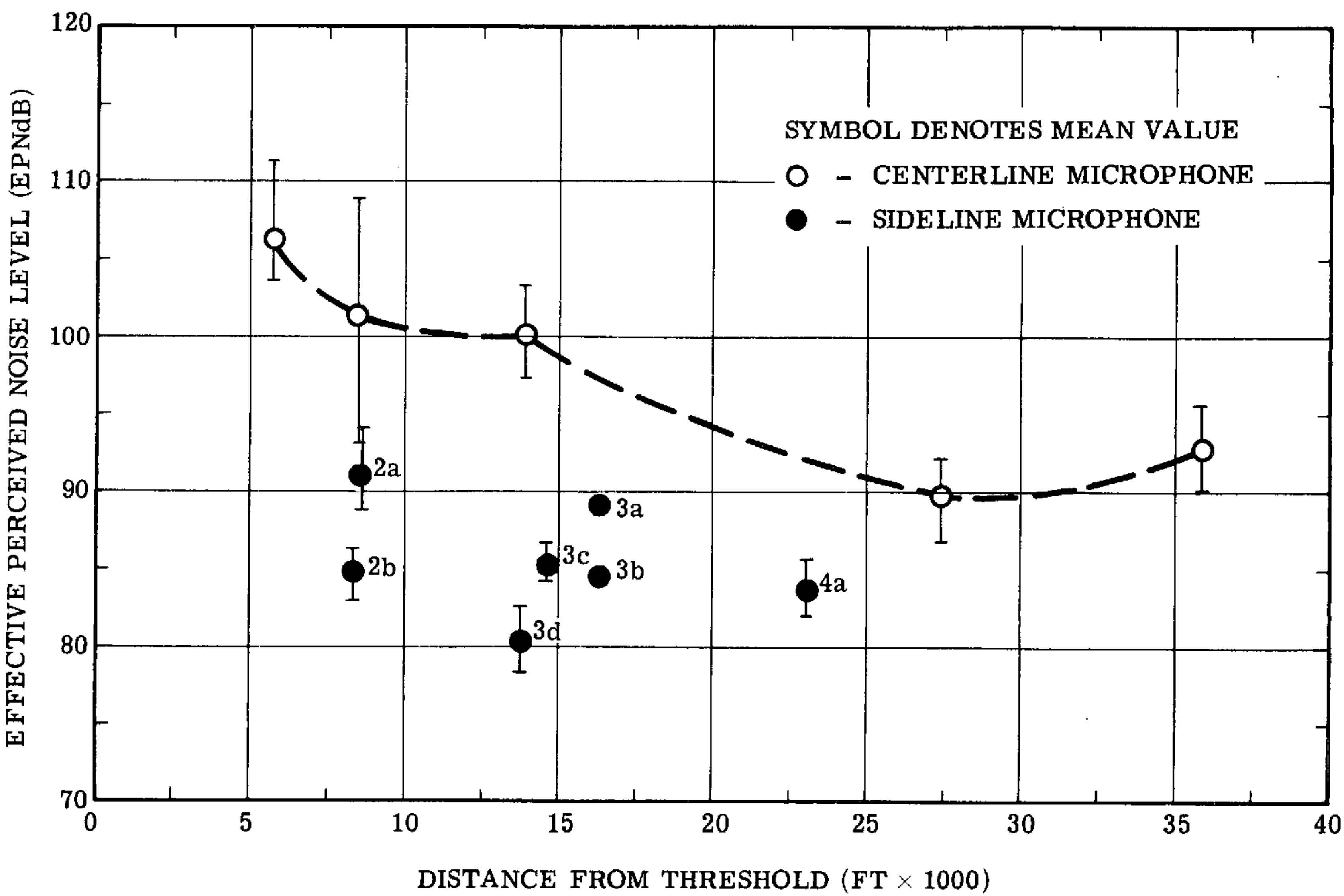


Figure 5. EPNL Versus Centerline Distance, Standard ILS (30° Flaps)

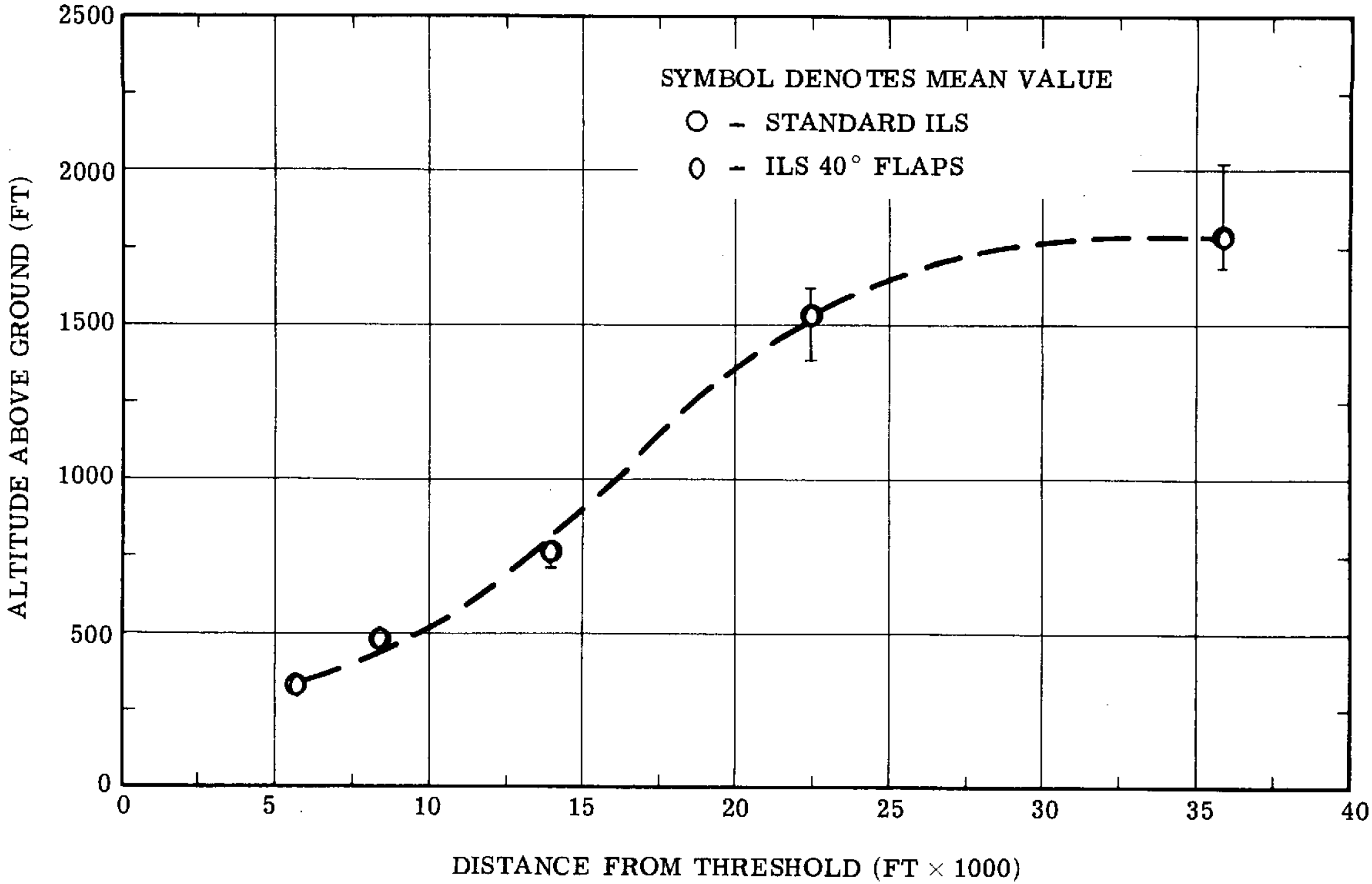


Figure 6. Altitude Versus Centerline Distance, Standard ILS (30° Flaps)

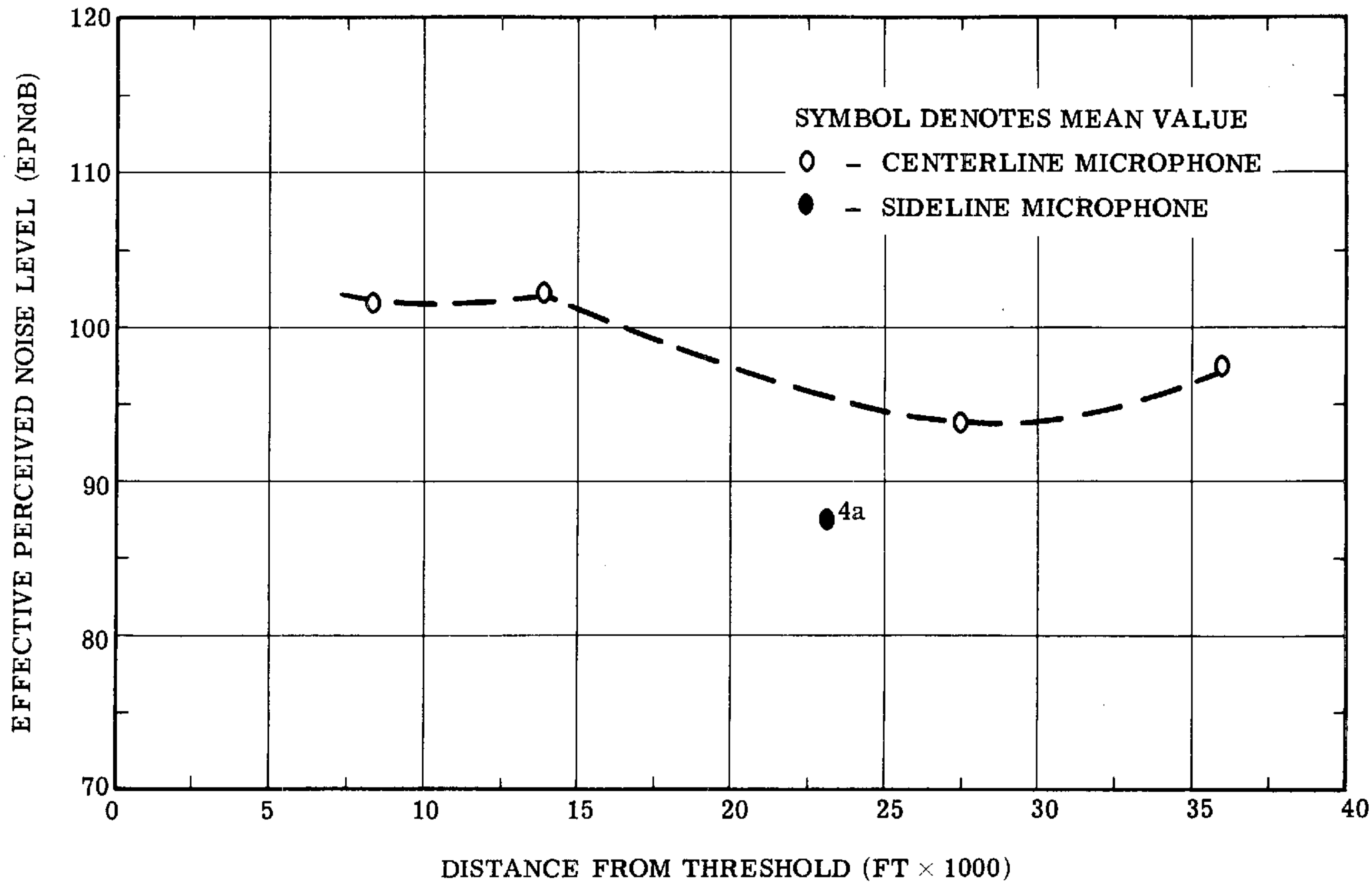


Figure 7. EPNL Versus Centerline Distance, ILS (40° Flaps)

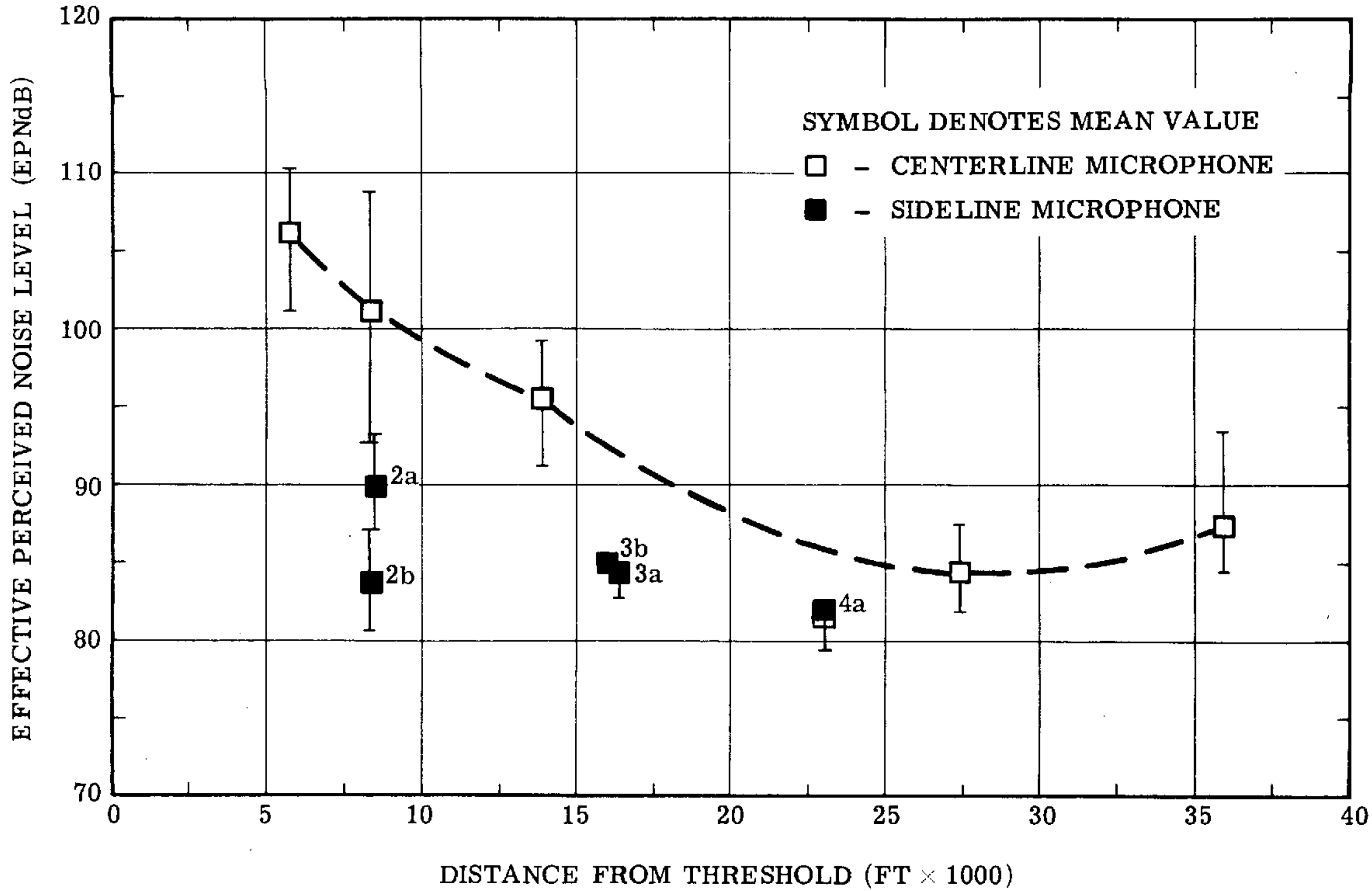


Figure 8. EPNL Versus Centerline Distance, Two Segment (6°/690' MT)

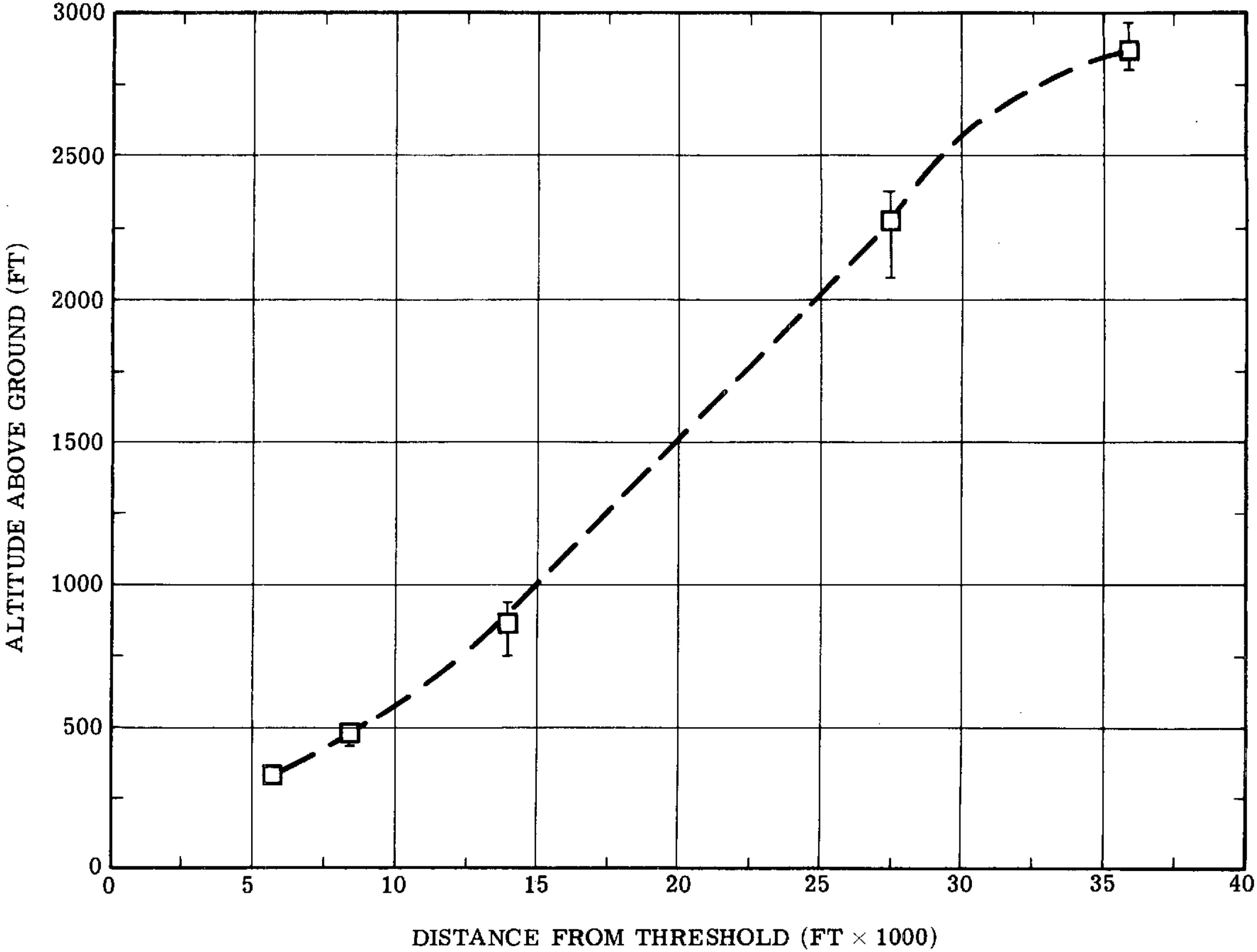


Figure 9. Altitude Versus Centerline Distance, Two Segment (6°/690' MT)

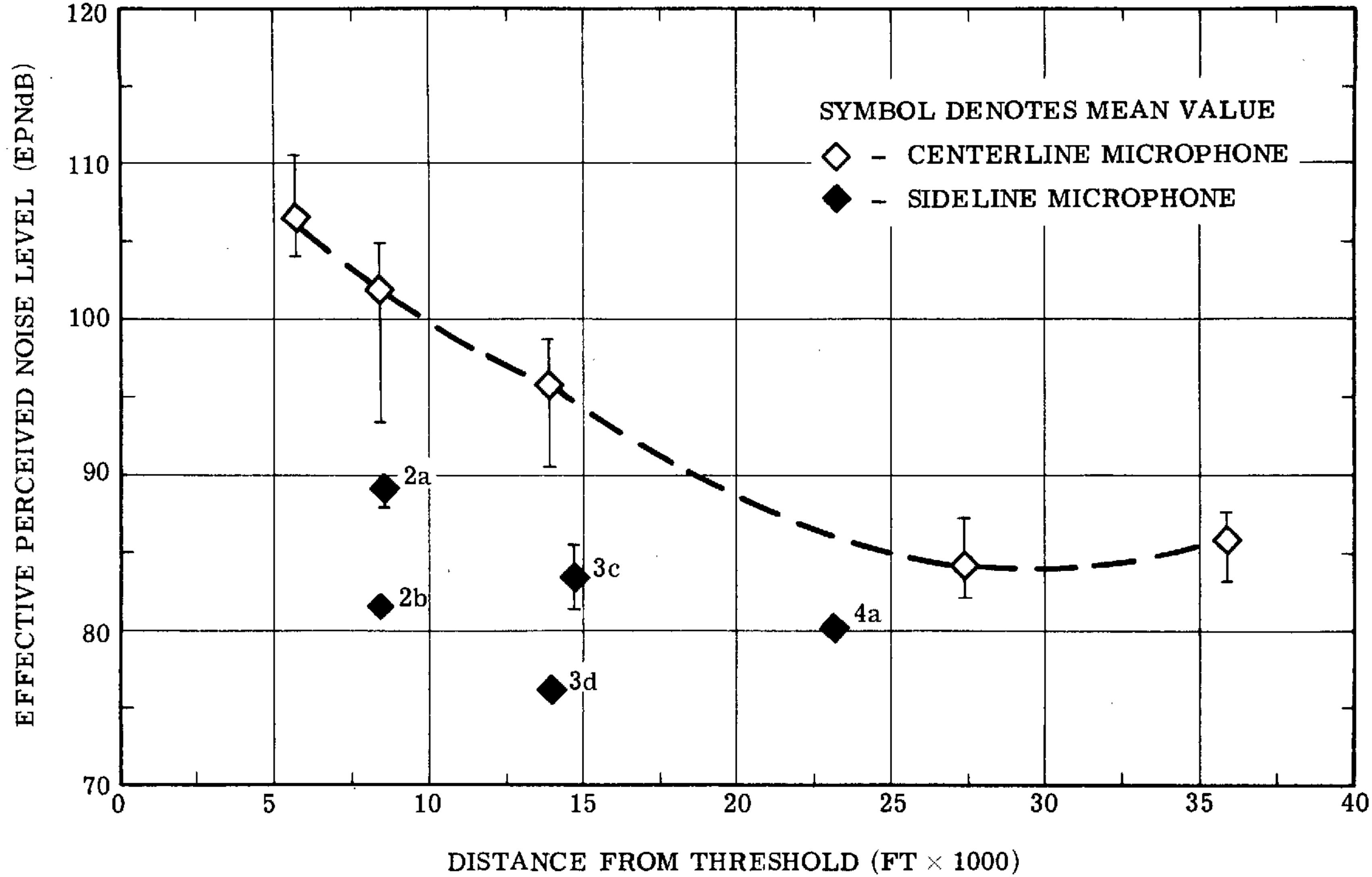


Figure 10. EPNL Versus Centerline Distance, Two Segment (6°/690' AT)

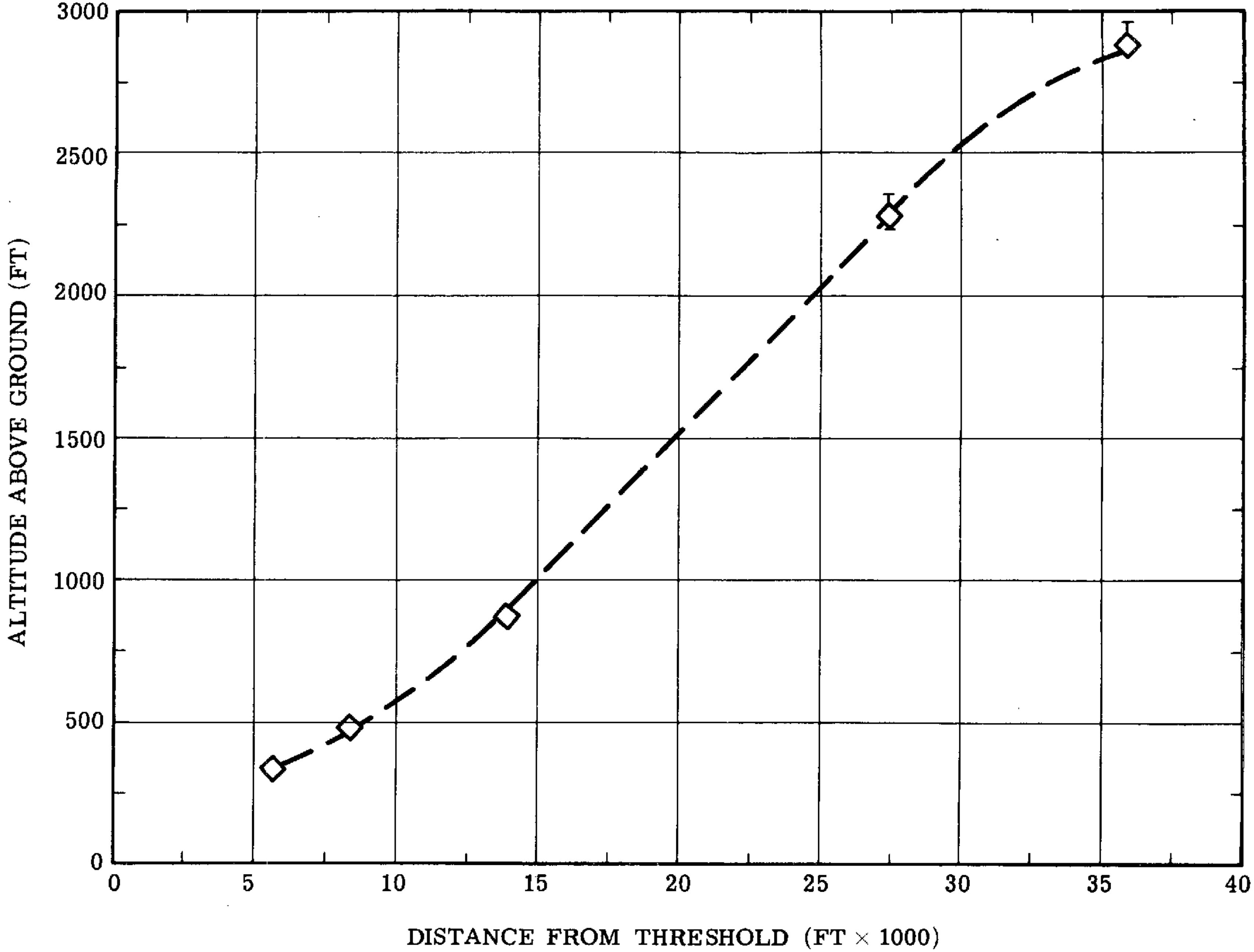


Figure 11. Altitude Versus Centerline Distance, Two Segment (6°/690' AT)

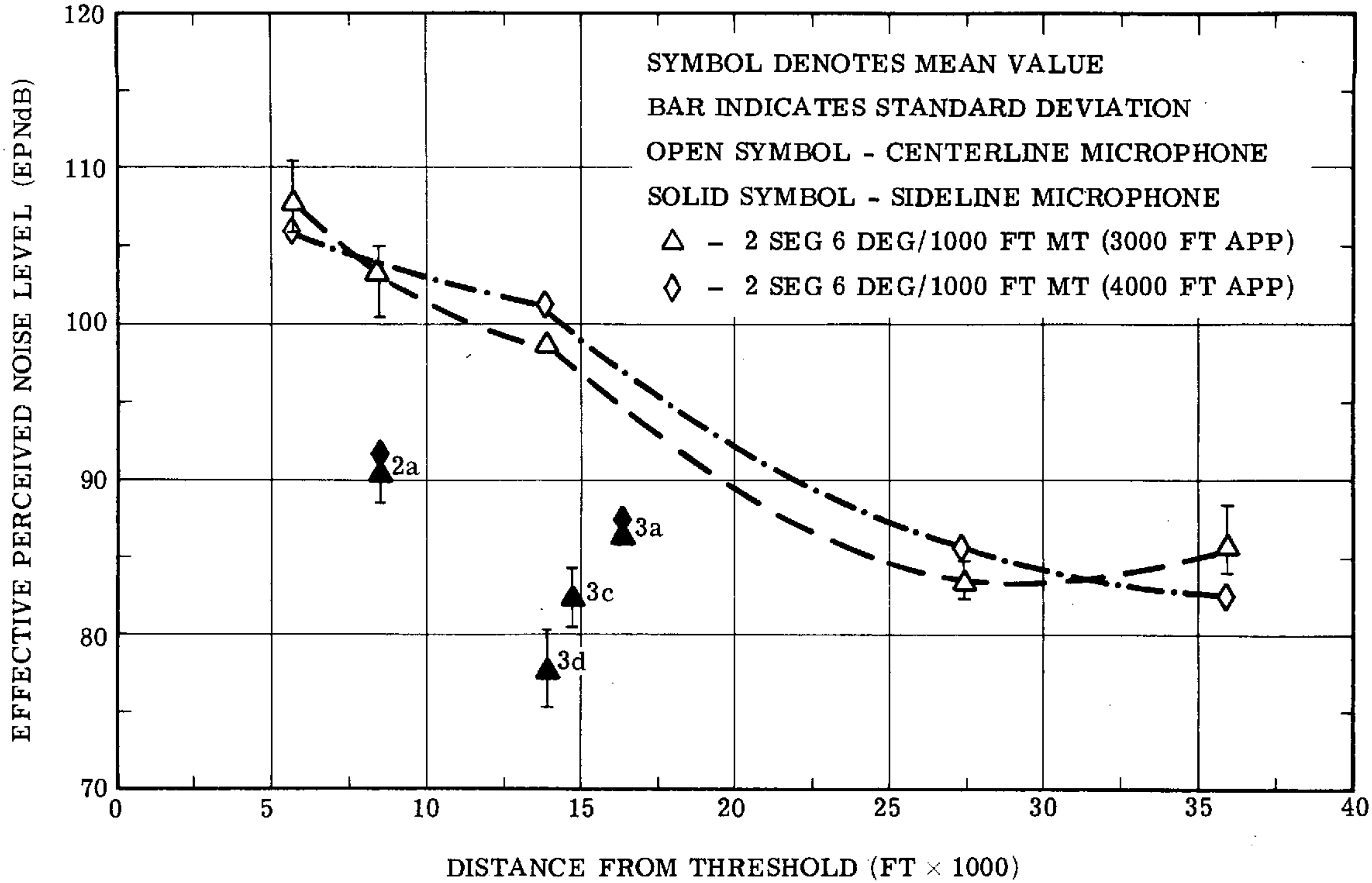


Figure 12. EPNL Versus Centerline Distance, Two Segment (6°/1000' MT)

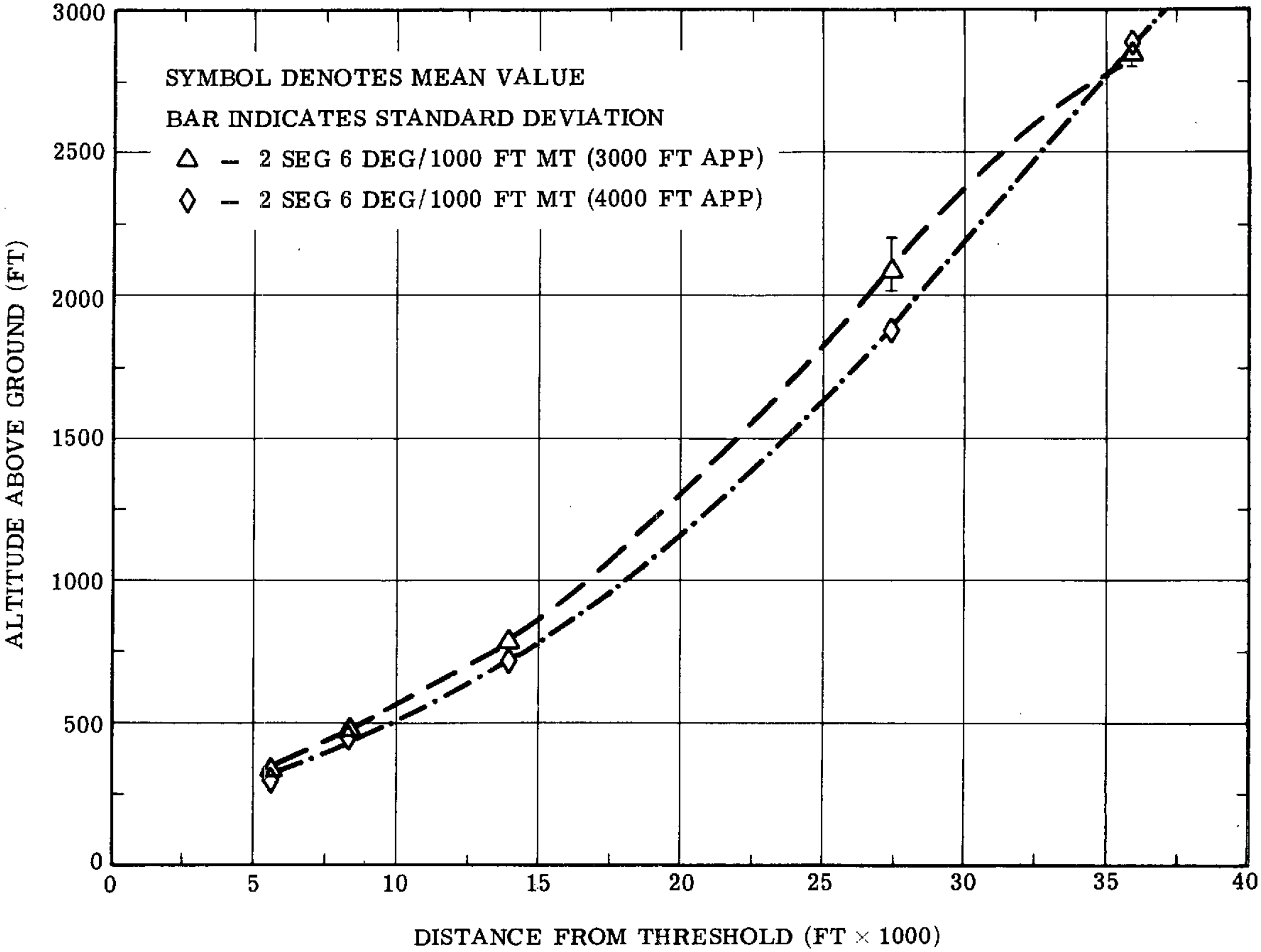


Figure 13. Altitude Versus Centerline Distance, Two Segment (6°/1000' MT)

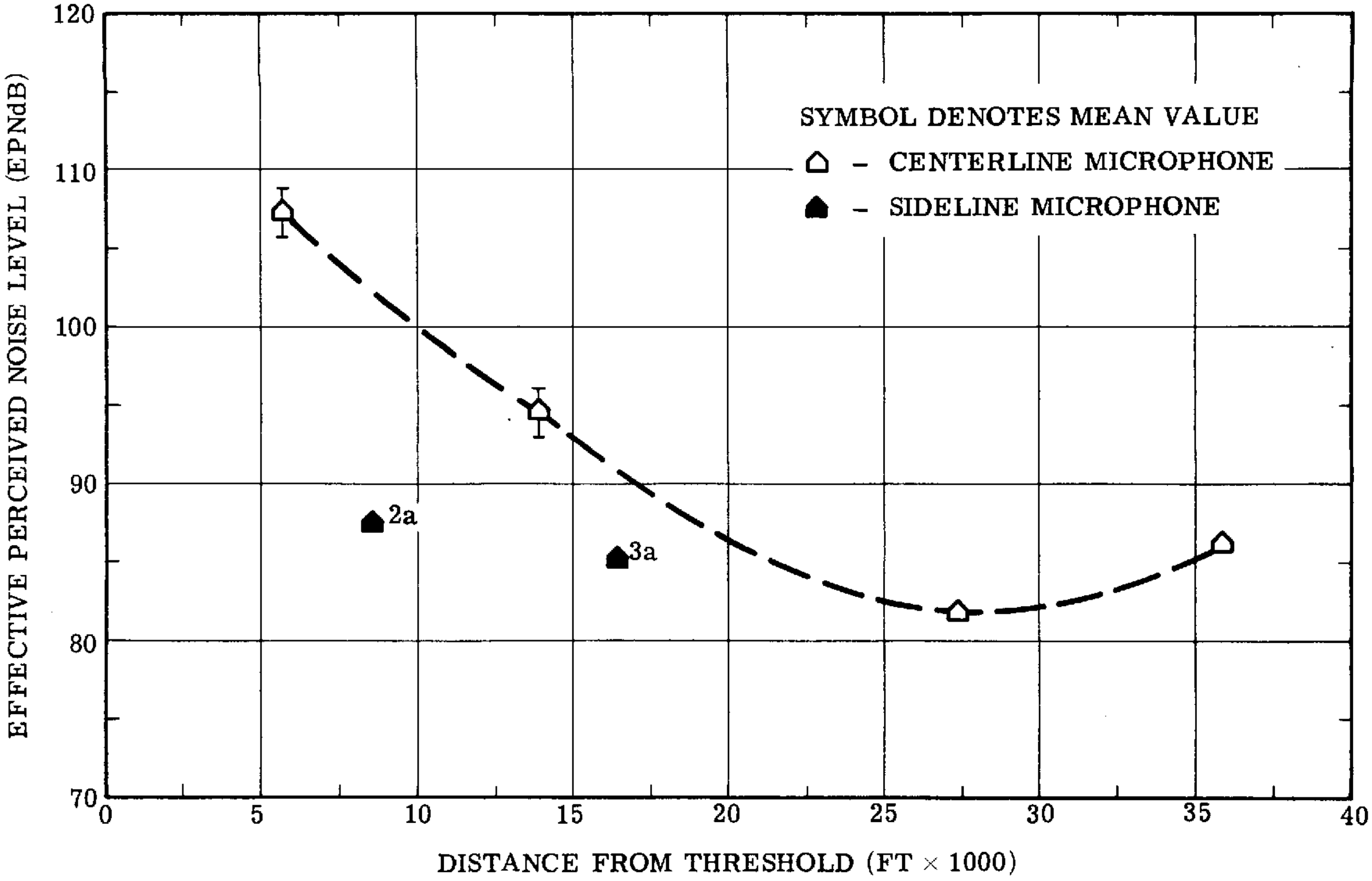


Figure 14. EPNL Versus Çenterline Distance, Two Segment (6°/500' MT)

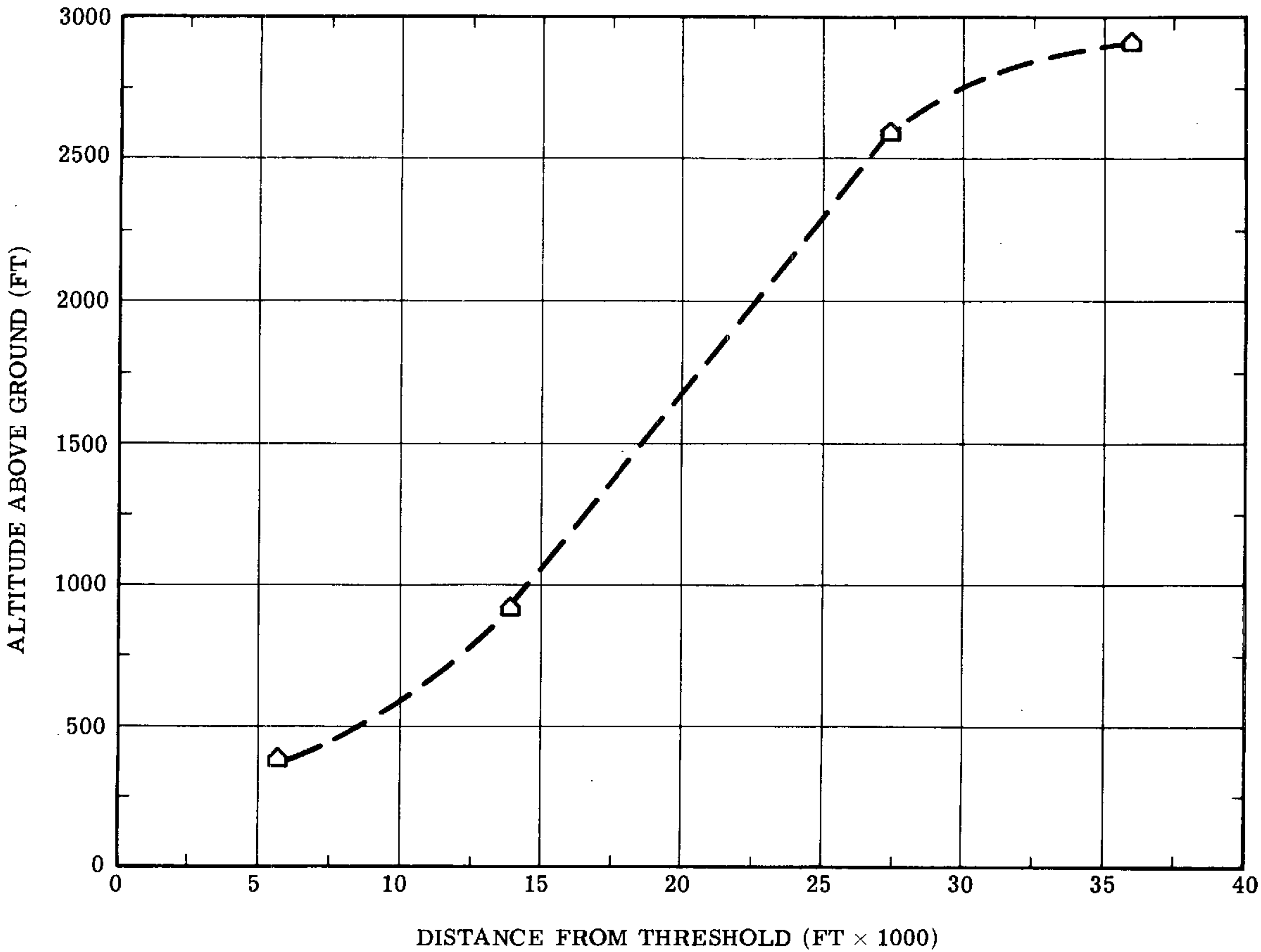


Figure 15. Altitude Versus Centerline Distance, Two Segment (6°/500' MT)

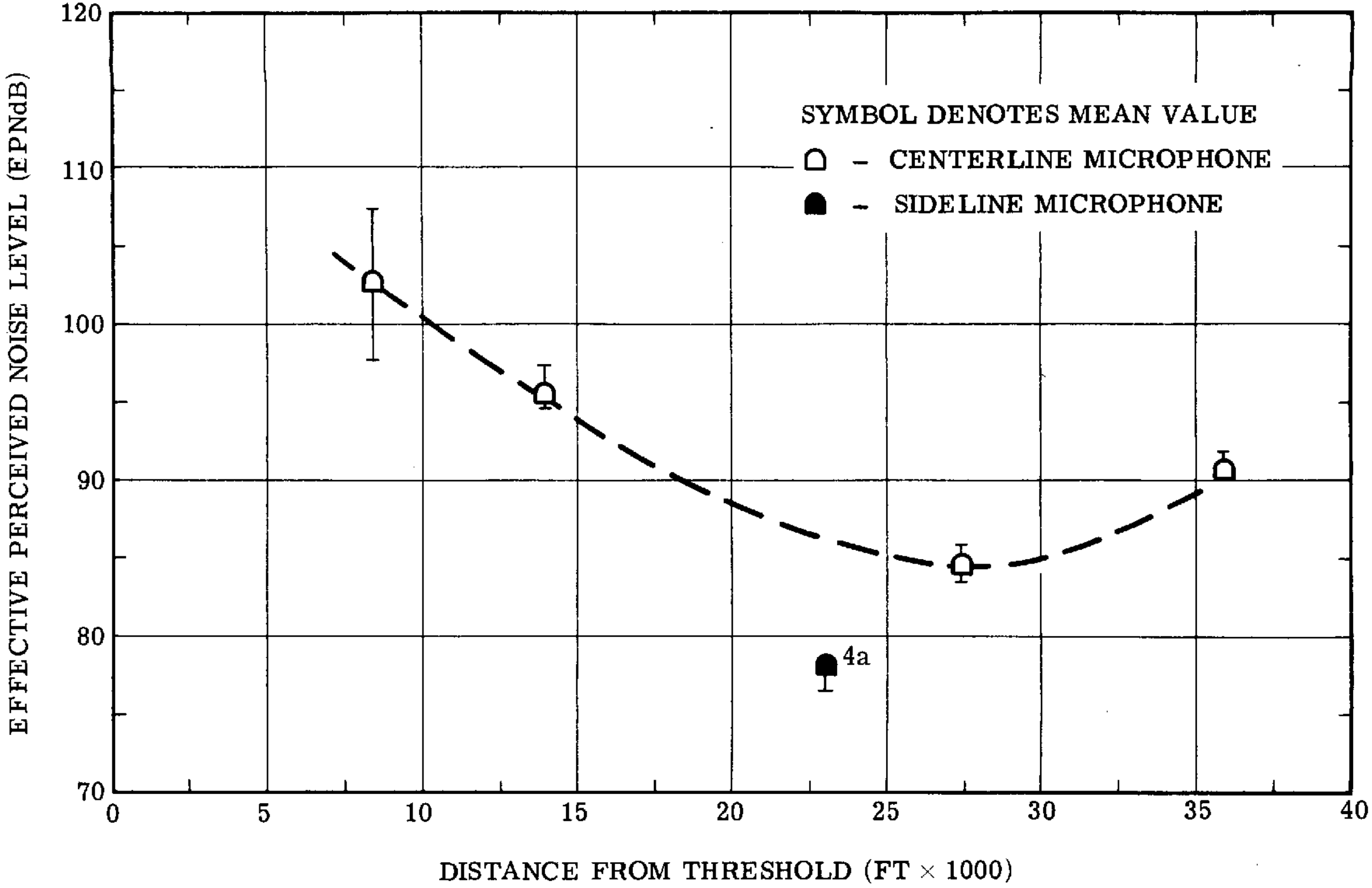


Figure 16. EPNL Versus Centerline Distance, Two Segment (6.5°/690' MT)

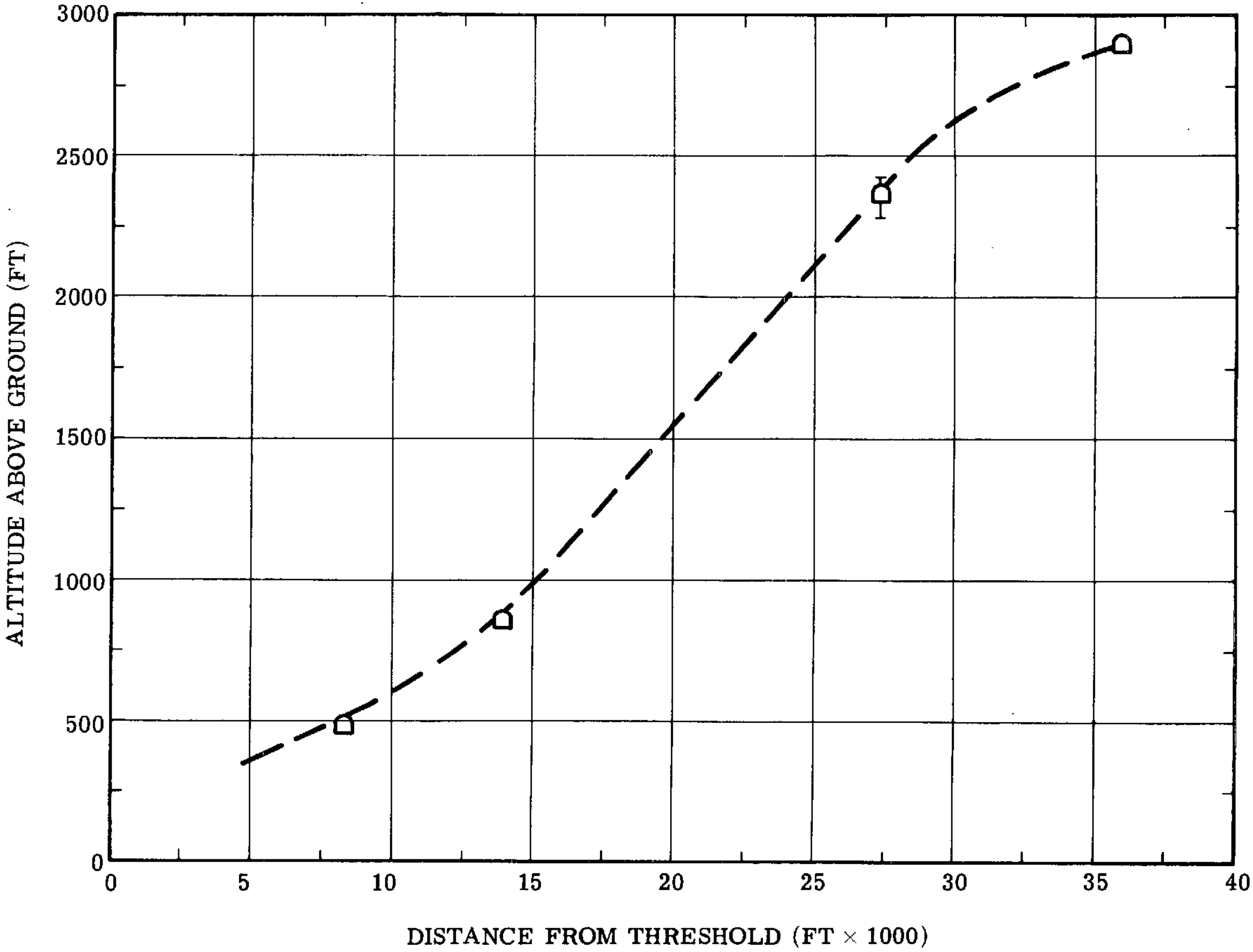


Figure 17. Altitude Versus Centerline Distance, Two Segment (6.5°/690' MT)

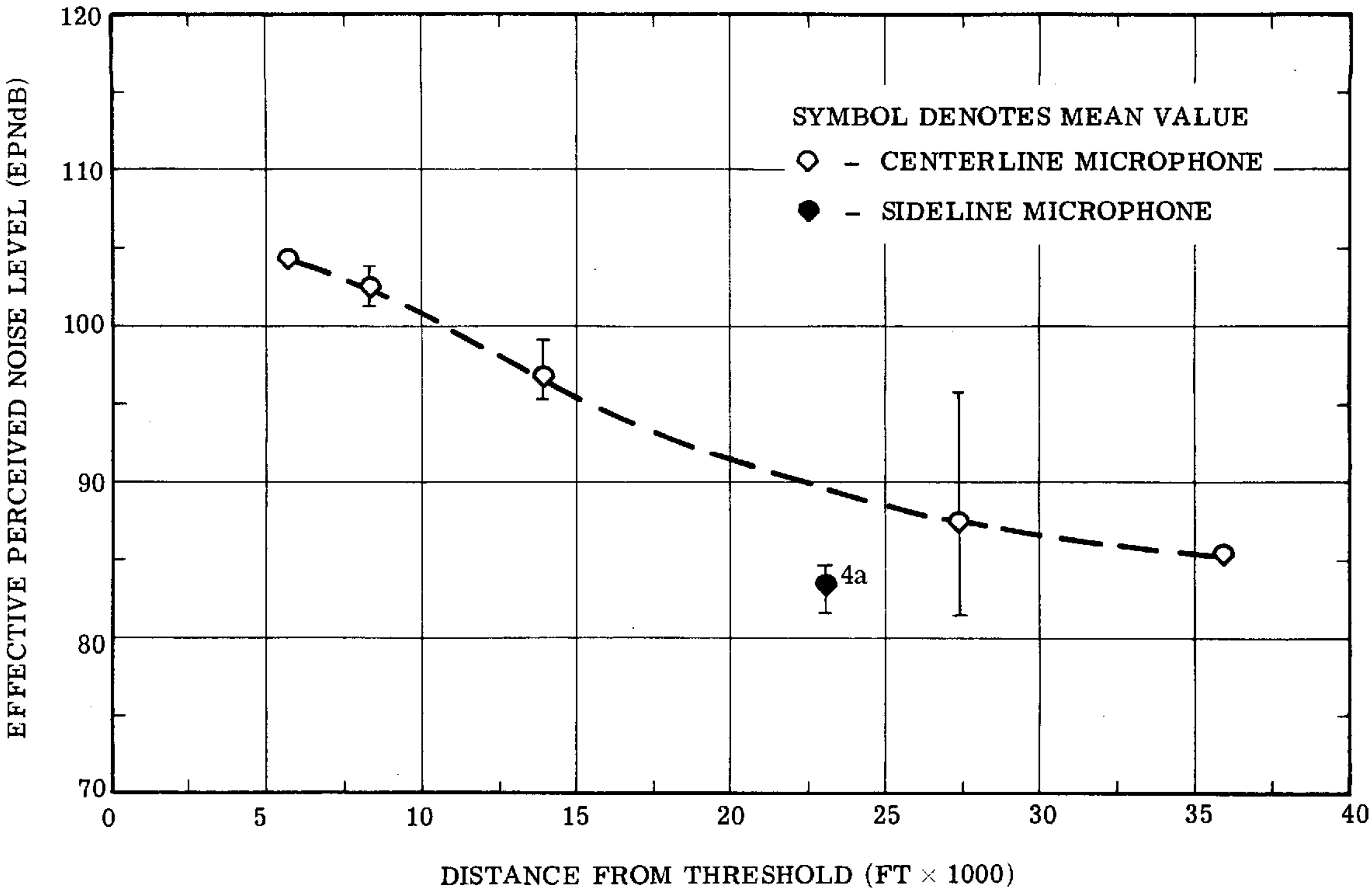


Figure 18. EPNL Versus Centerline Distance, Two Segment (5.2°/690' MT)

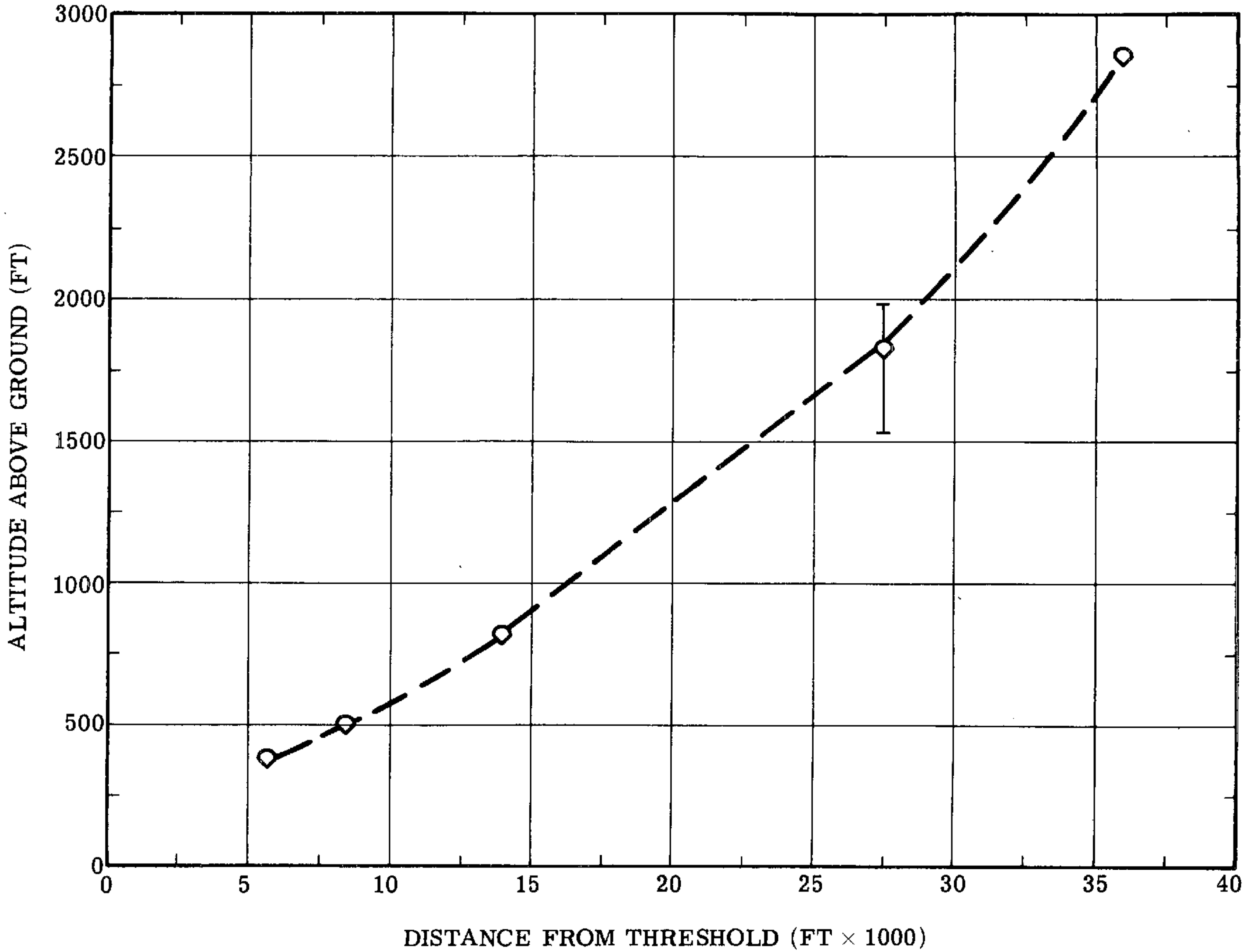


Figure 19. Altitude Versus Centerline Distance, Two Segment (5.2°/690' MT)

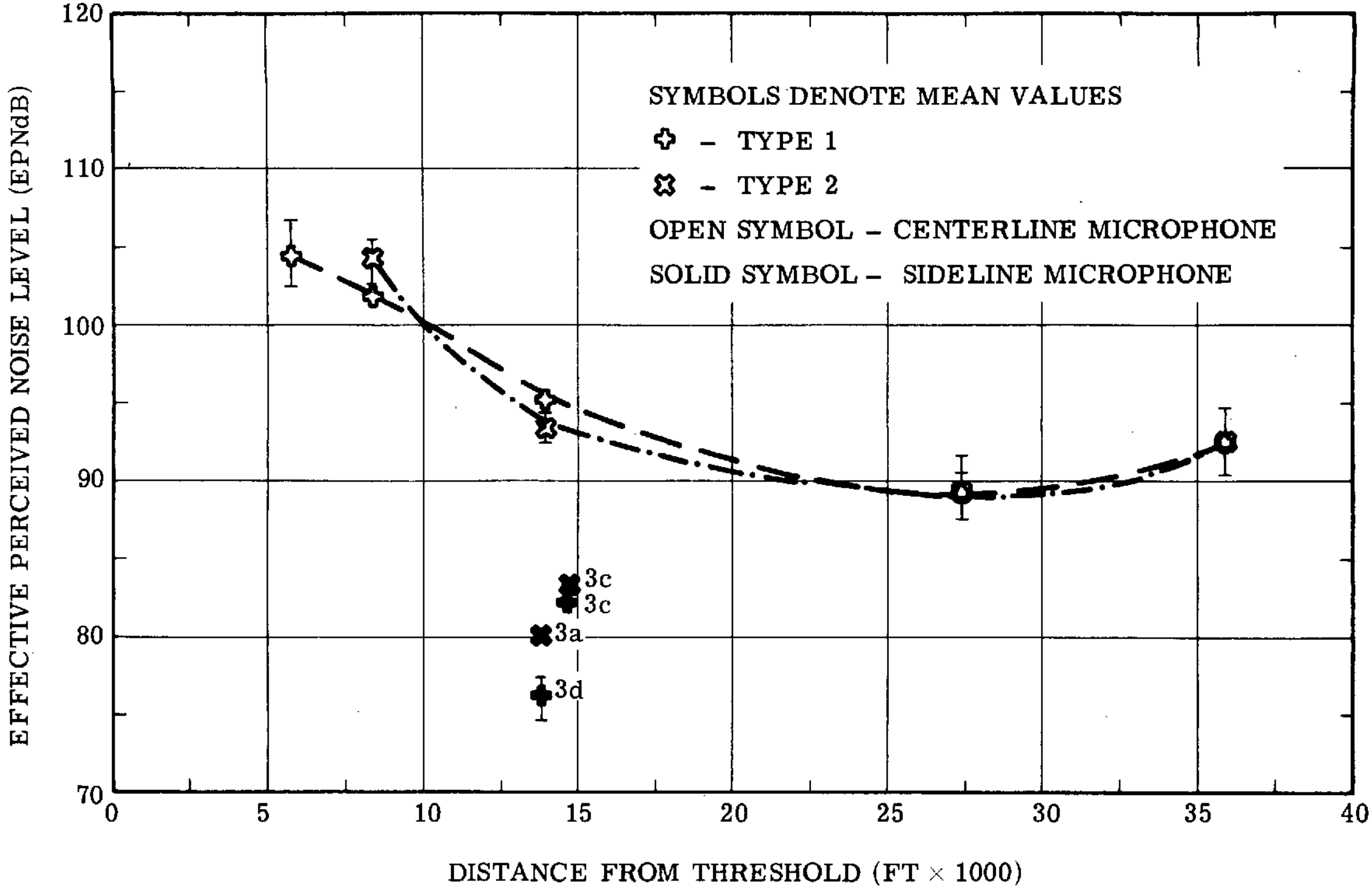


Figure 20. EPNL Versus Centerline Distance, ILS Delayed Flaps

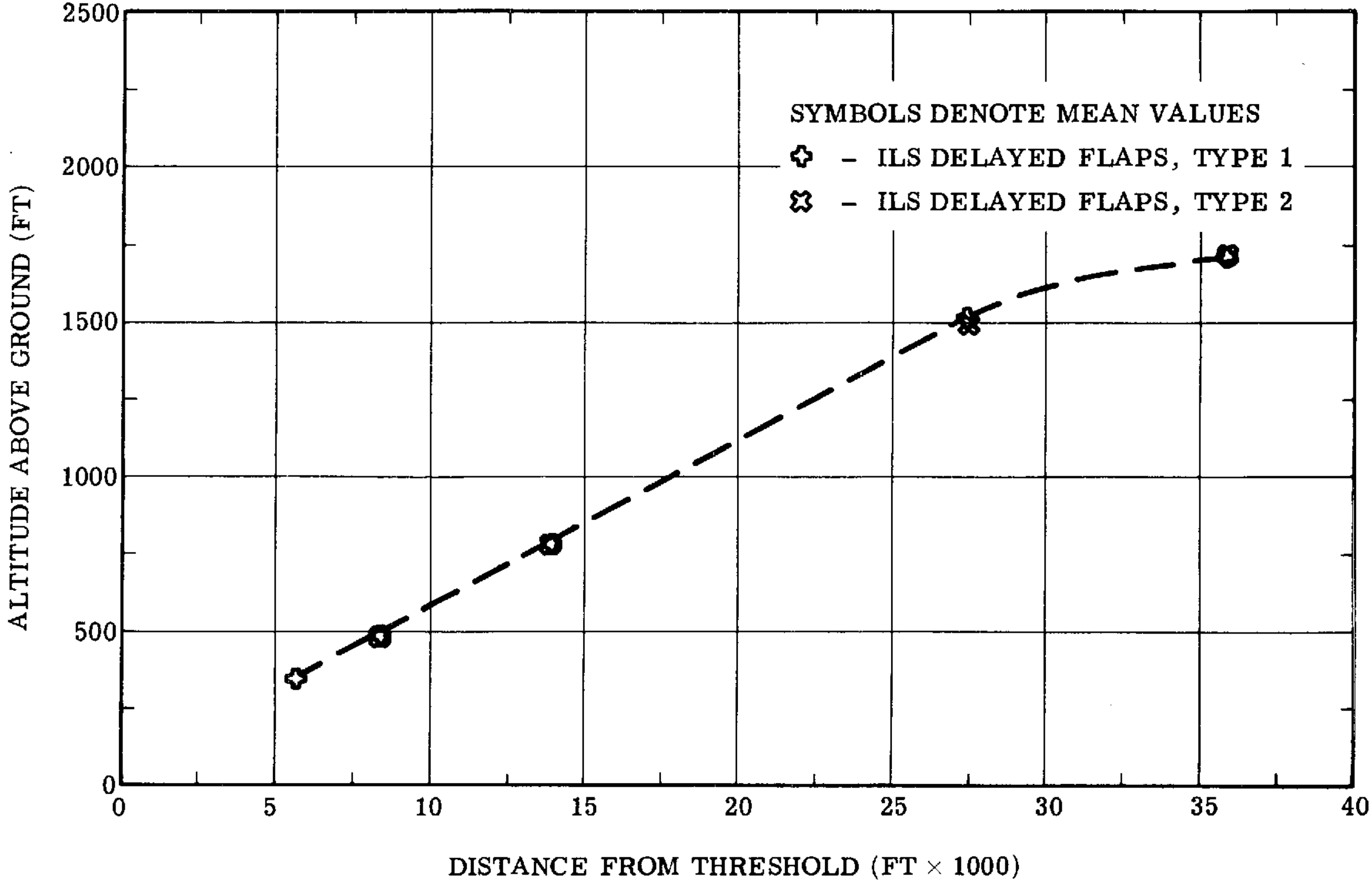


Figure 21. Altitude Versus Centerline Distance, ILS Delayed Flaps

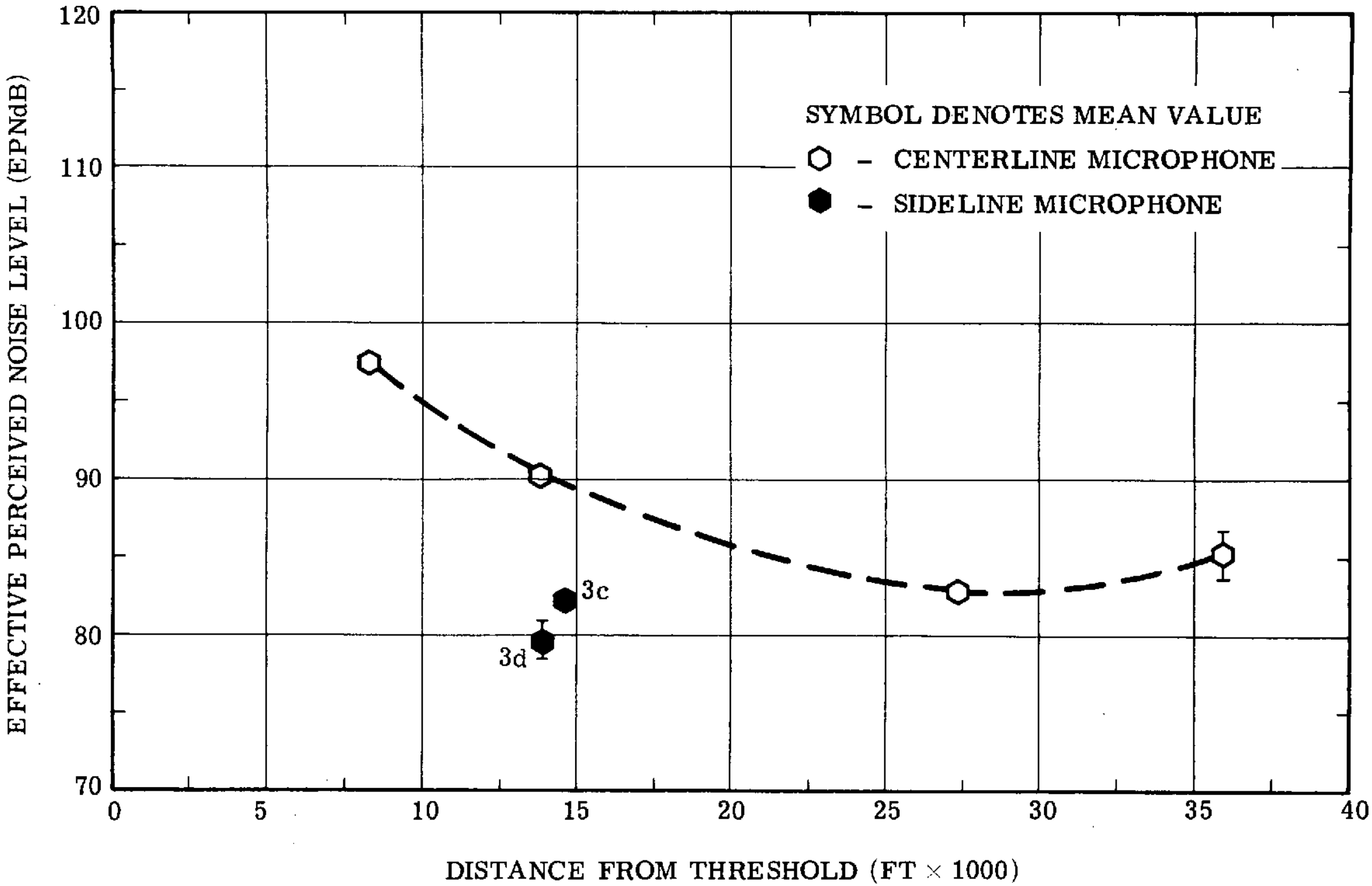


Figure 22. EPNL Versus Centerline Distance, Two Segment (6.5°/500' 1 DOT High)

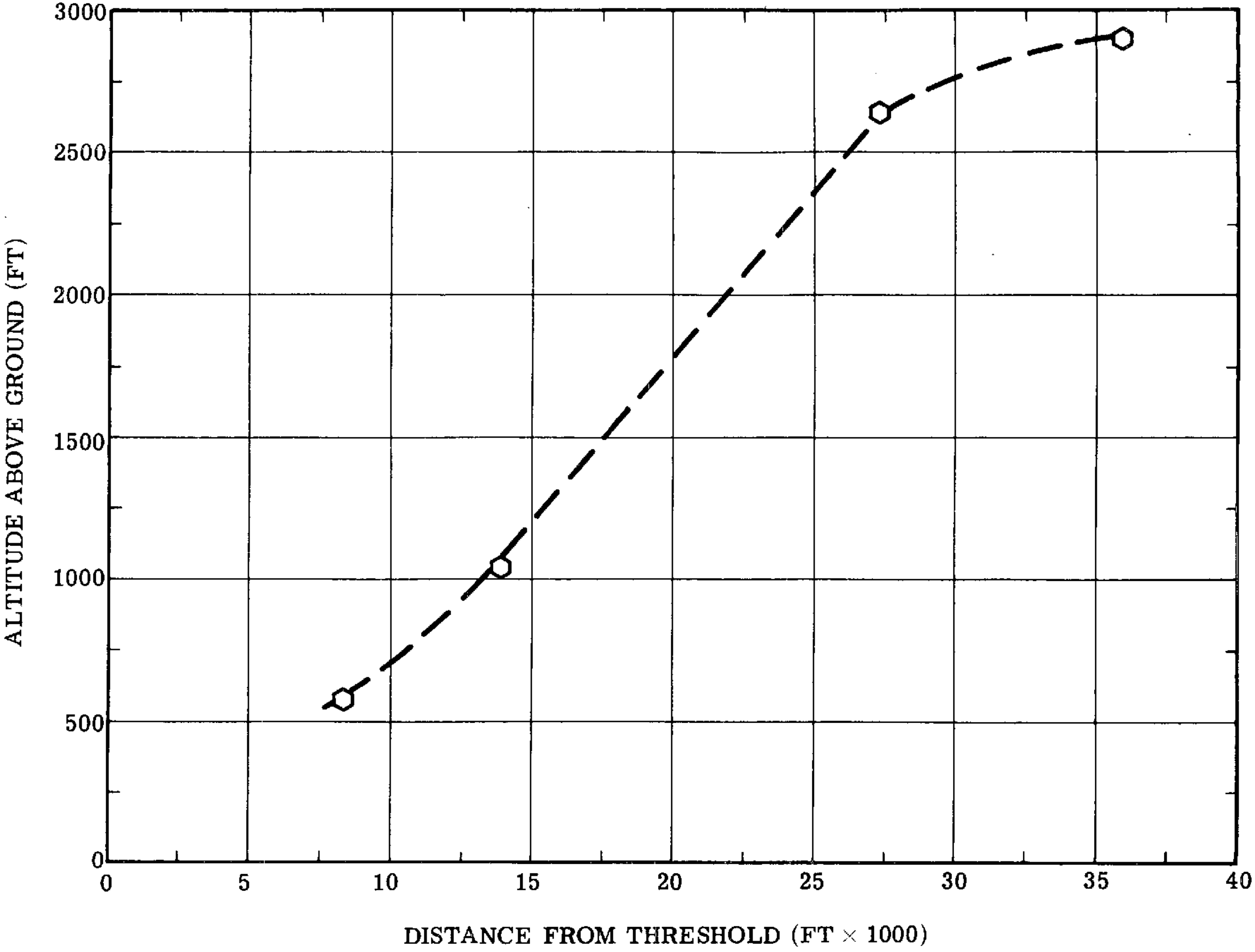


Figure 23. Altitude Versus Centerline Distance, Two Segment (6.5°/500' 1 DOT High)

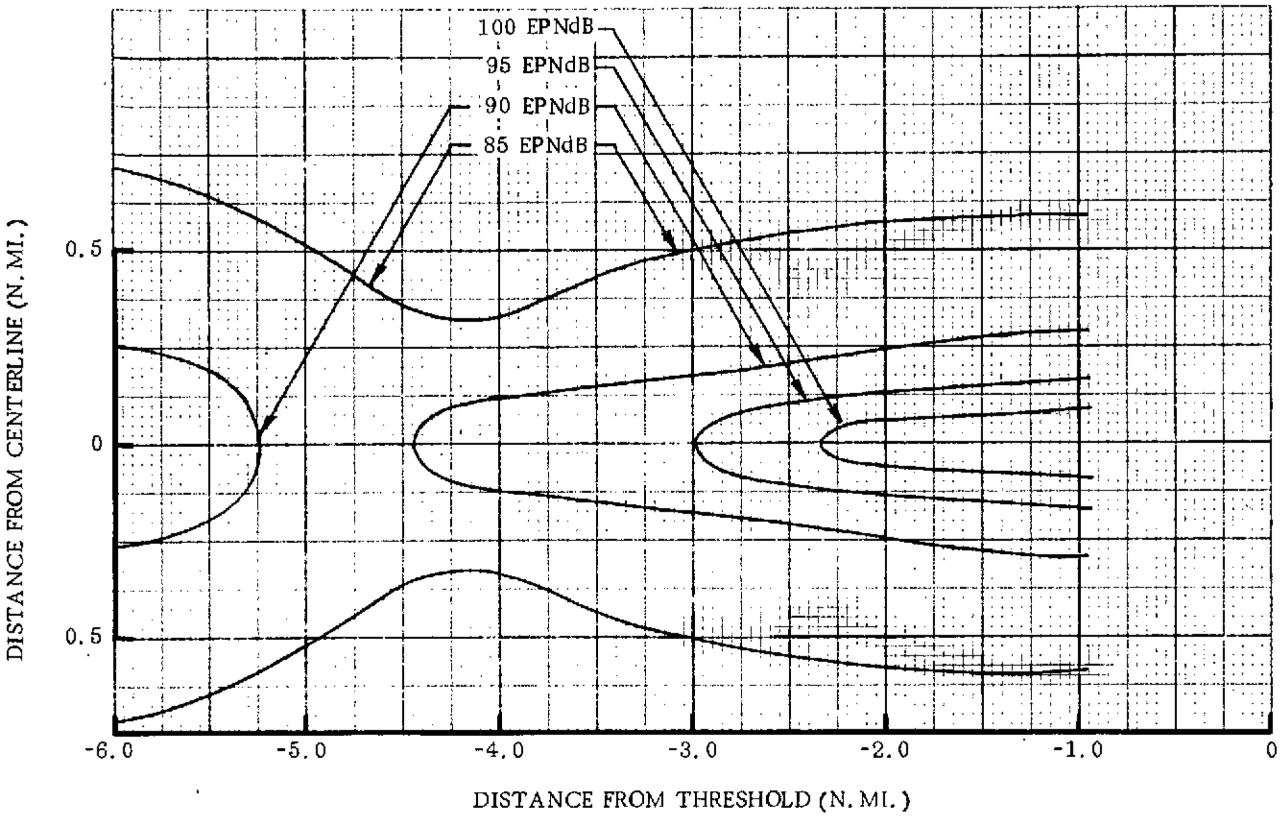


Figure 24. Noise Contours – ILS 30 Deg Flaps

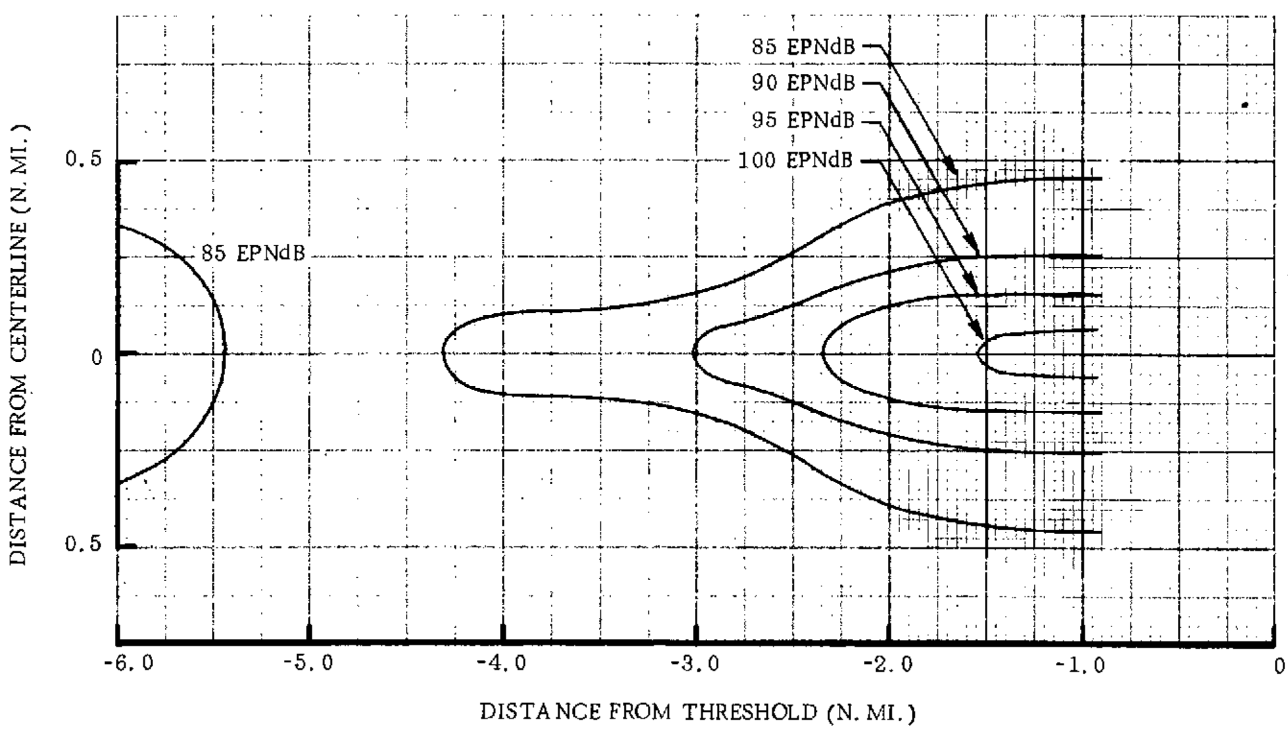


Figure 25. Noise Contours – Two Segment 6 Deg/690 Ft MT and AT

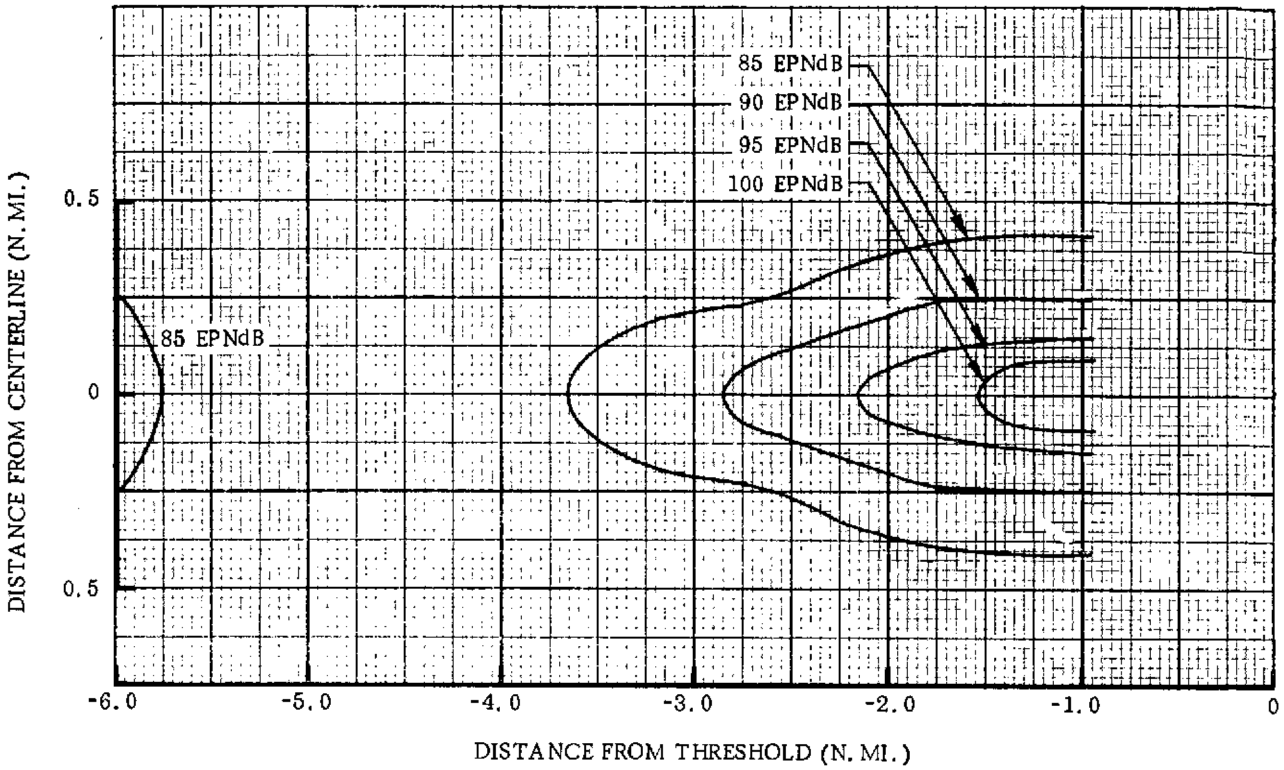


Figure 26. Noise Contours – Two Segment 6 Deg/500 Ft MT

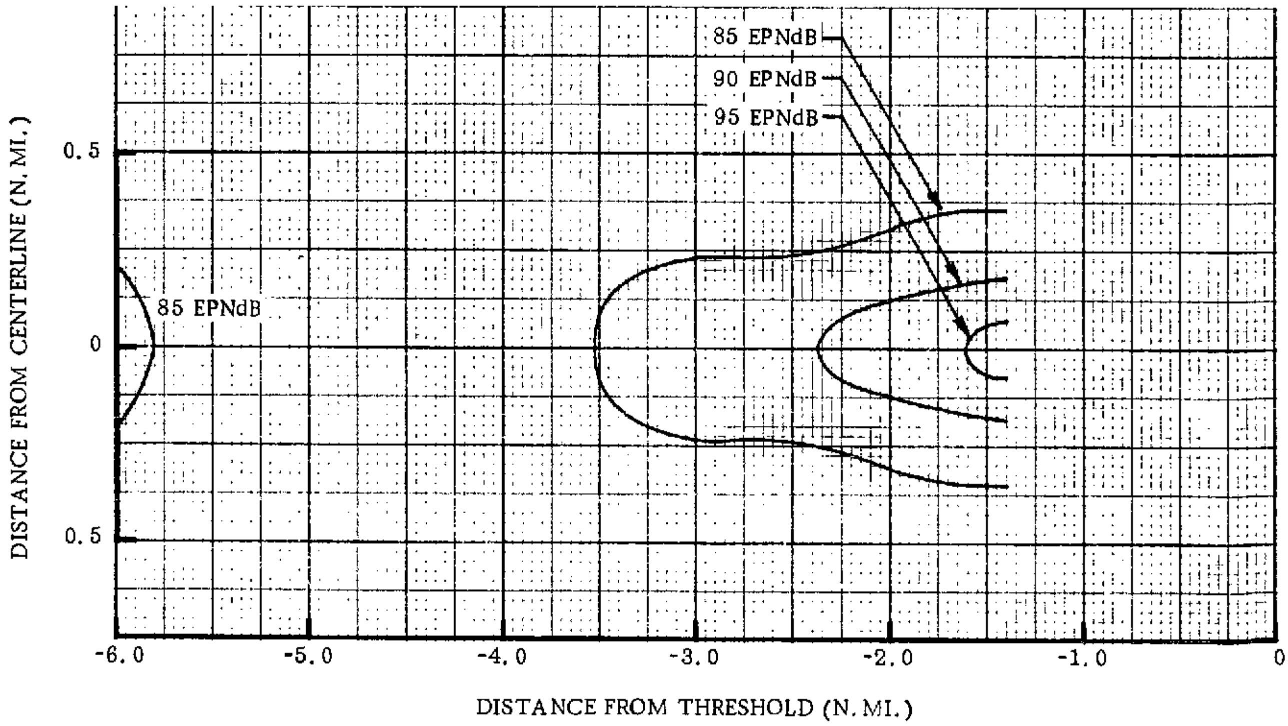


Figure 27. Noise Contours – Two Segment 6.5 Deg/500 Ft, 1 Dot High

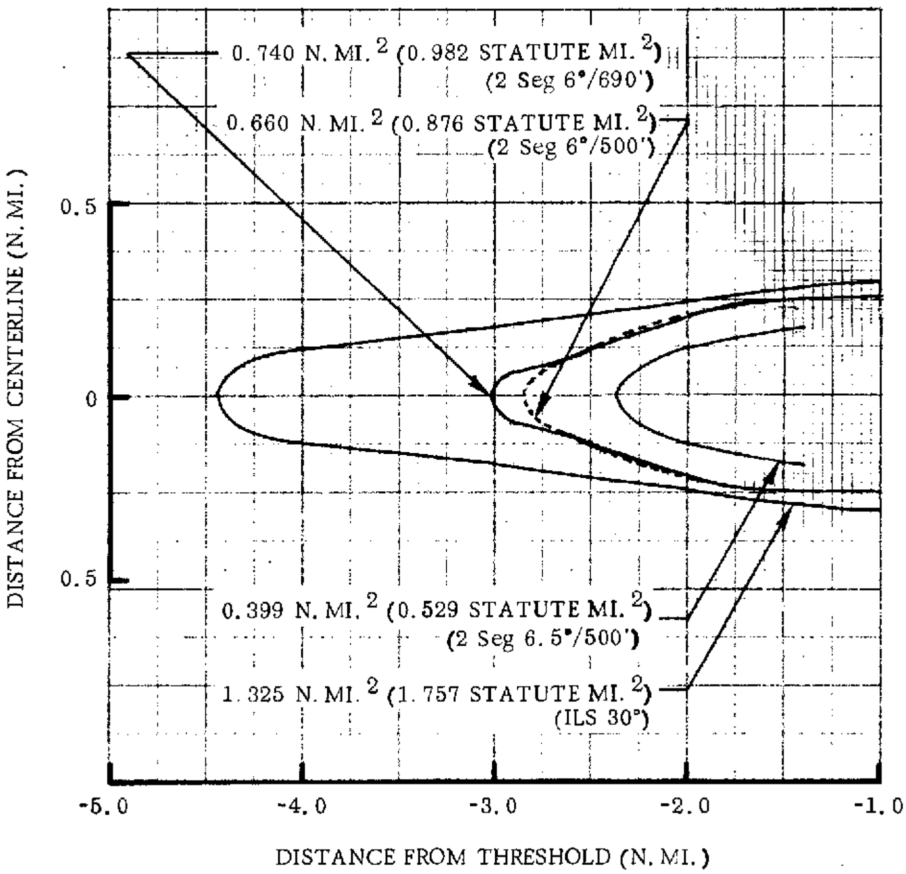


Figure 28. Comparison of 90-EPNdB Contours

Appendix A
BOEING 737 ILS APPROACHES

During the noise measurement program United Air Lines made standard ILS approaches during their revenue flights at Stockton. The noise measured on these Boeing 737 approaches is shown in Table A-I.

Table A-I. 737 ILS Approaches

Run	EPNL	SR CPA (ft)	Site
2763	113.3	350	1
2764	111.9	350	1
2600	110.6	485	2
2650	110.9	510	2
2763	103.0	480	2
2764	109.8	480	2
2600	105.0	710	3
2650	107.8	800	3
2763	100.7	810	3
2764	103.2	785	3
2763	95.0	1400	5
2763	90.0	3076	3c
2763	80.8	4820	3d
2764	85.4	4820	3d

REFERENCES

Federal Aviation Regulations, Part 36 - Noise Standards: Aircraft Type Certification, November 1969.